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PC MAGAZINE

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Special Pullout Section: Everything You Need to Know to Connect on the Road

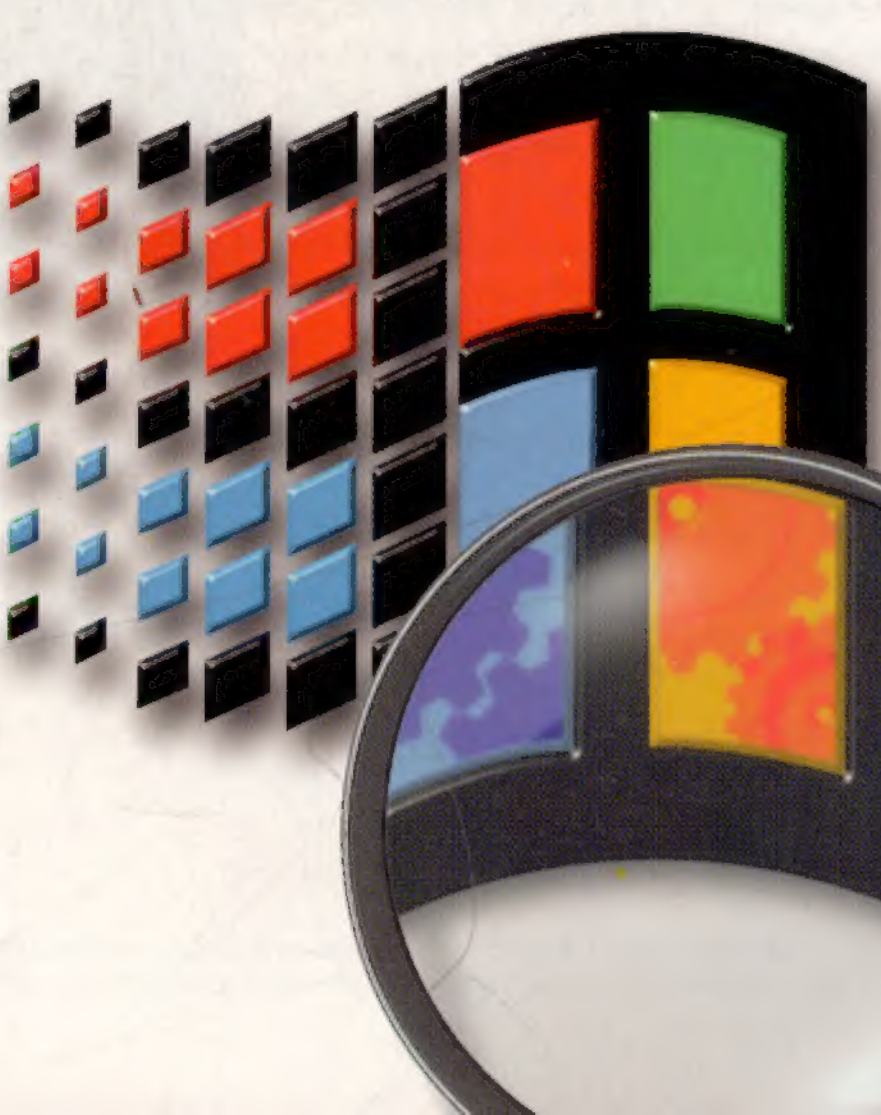
Portable Projectors Get Lighter And Brighter

Net Tools: First V.90 PC Card Modems

WWW.PCMAG.COM THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOL. 17 NO. 14 AUGUST 1998

WINDOWS 98
FIRST TEST RESULTS

PERFORMANCE
COMPATIBILITY
UPGRADES



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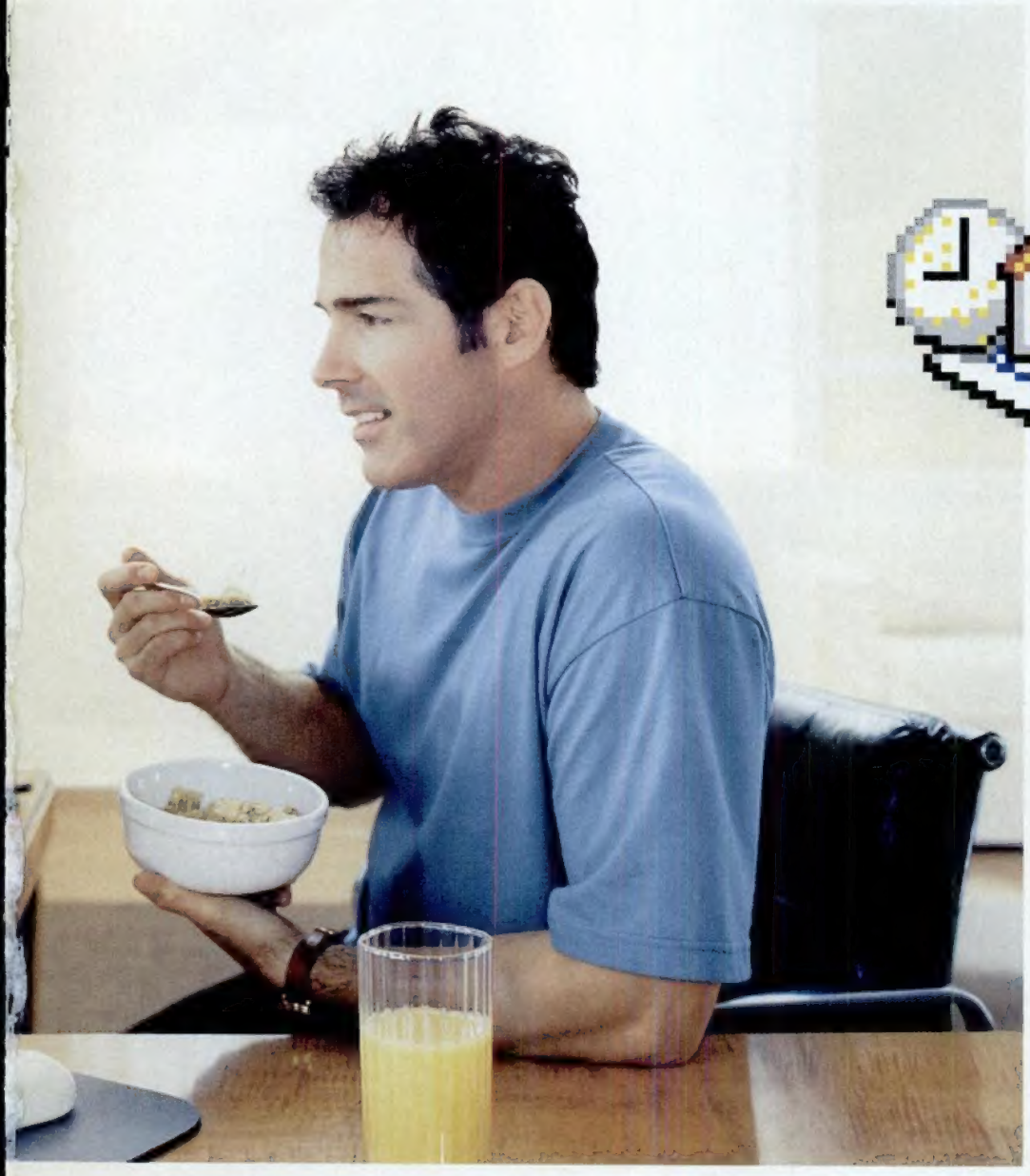

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The Most Difficult Upgrade

A good part of this issue contains information about upgrading to Windows 98. The topics we cover include what you'll get if you upgrade, the pros and cons of upgrading, and whether or not it's worth the effort to do so. But although upgrading software is an important issue, in some respects it's easier to upgrade your software than to upgrade or change your hardware. And that just doesn't make sense anymore.

Chances are that when you buy a new computer, you get one with the operating system already installed. And it's fairly easy to install the same applications you had on an older system. In fact, most large companies already have custom builds of the applications they want their employees to have. We're also seeing a big growth in cloning software—again used by large companies that have the appropriate licenses—which takes a selection of software and creates an exact copy on dozens or hundreds of machines. All this is part of lowering the cost of setting up new systems, and that's great.

But what about the more personal things you do on your machine? Odds are that you've created your own personal dictionary in Word or WordPerfect. Today's software typically lets you modify the toolbars and menus: Perhaps you've done that. You may have macros you always start your files with. You may have created unique templates.

In Windows itself, you may have chosen a different background or arrangement of icons. You may have entered phone numbers or passwords in dial-up networking. Your browser may have cookies and bookmarks you want to keep.

This is part of what makes a personal computer *personal*. And it's nearly impossible to get all of this to travel with you to a new computer. Some applications make the file transfer easier than others. Lotus Notes, for instance, stores much of your personal setup in a "desktop" file. But with Microsoft Office, you have different customization taking place in lots of individual files for separate applications.

Advocates of server-based network computing think they have an answer. Store all the applications on one server, and store all the settings there as well. That way, when you log on to any computer anywhere, all those preferences and all those applications come with you. Microsoft, quick to jump on a bandwagon, is talking about similar features for Win NT 5, though that isn't here yet. But in some cases, the server-based solutions I've seen don't leave much leeway for personalization. And they don't do much for those of us who do most of our computing on portable computers that are disconnected from the network much of the time.

A better answer would be for each application (and Windows itself) to store all things that are personalized in a single file that could be easily moved to another computer. It should be separate from the Windows registry, which contains lots of information that is specific to the machine, not the application. It doesn't necessarily have to be the file that the program uses on your machine. But it would be great if you could choose a command in Microsoft Office, Lotus SmartSuite, or Corel WordPerfect to gather up all the personalized material—templates, changed menus, address books, dictionaries, and so on—in a single file. Then we would need a command on the next computer to read the contents of such a file and put everything back in its rightful place.

Frankly, this doesn't sound that hard, and my guess is that most of us would use it more than we would use half of the new features we are seeing in the new office suites, for example. Not all of us will use our word processors to create Web pages, but almost all of us will get new machines someday.

You'd think software vendors would want to make it easier to upgrade to new hardware as well. With new machines come more processing, more and larger hard disks, and the opportunity for more software upgrades.

But they've got to make it all easier.

MICHAEL J. MILLER

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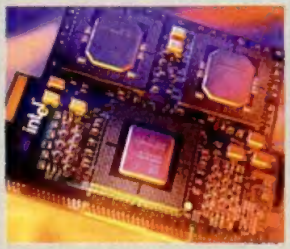

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Windows 98 Put to the Test

BY MICHAEL J. MILLER

We ran the shipping version of Microsoft's latest OS straight to our benches and put it through its paces. You may have seen our test results posted online at *www.pcmag.com*. Now here's the full story. What we discovered led us to some pretty clear recommendations about whether or not you should upgrade **100**

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Windows 98 Cheat Sheet

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54 New Laptop PCs

BY BILL HOWARD

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BY ALFRED POOR

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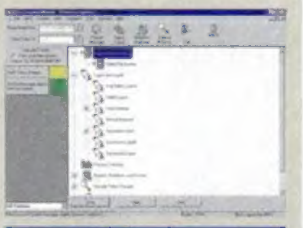

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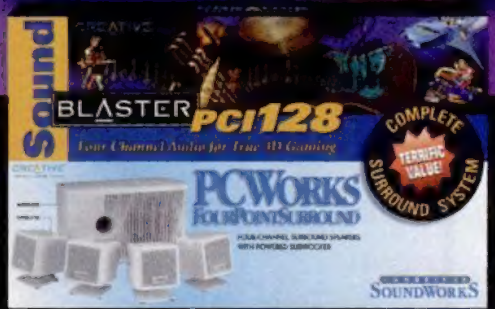

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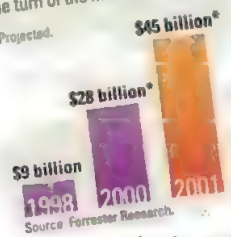
Pipeline

Portal-Page Bonanza

"The Internet has finally reached the right critical mass for all the rosy projections about e-commerce to come true," said Netscape CEO Jim Barksdale at his company's recent strategy conference.

Netscape is shifting its strategy toward e-commerce, and it's beginning by overhauling its Web portal site Netcenter. Portal sites, such as America Online, Netcenter, and Yahoo!—which browsers use as launching points—have been in a mad rush to incorporate free services, such as e-mail and chat, to attract more eyeballs. The future for such sites, though, is fee-based services. According to Forrester Research, revenues from fee-based services at portal sites will grow to $45 billion by 2001.

Revenues from fee-based services at Web portal sites are expected to hit $45 billion by the turn of the millennium.



Big media companies' interest in portal sites has recently picked up. NBC has bought a portion of CINet's Snap, and Disney has bought an interest in InfoSeek.

Bill Gates agrees that e-commerce has huge potential. At his annual CEO Summit in Seattle, the Microsoft CEO focused on the demographics fueling e-commerce. "There's a new generation of consumers coming, who have gone to college and expect to be able to interact through the Internet. Whether it's with their bank or a car dealer, they're going to use the Internet," he said.

Gates noted, though, that the commerce boom hasn't fully arrived yet. "If you track Internet sales as a percentage of product categories, there are few gigantic successes today. In cars, about 2 1/2 percent of sales are Internet-based. Travel will soon be crossing over about 1 percent."

Online Bookstores (the Sequel)

The battle of the online bookstores erupted on another front recently when Amazon.com launched a music store with more than 150,000 CD titles, at up to 40 percent off retail. Also, Amazon.com has stated its intention to get into video sales. Its purchase of the Internet Movie Database in April was a first step in that direction.

Meanwhile, Barnes & Noble recently upgraded its site with personalization features and now has a software store selling 1,000 titles. And more bookstore competition is coming. Borders Books hasn't made its big online push yet, and German publishing giant Bertelsmann intends to build a huge international online bookstore.

ILLUSTRATIONS BY PAUL CORIO (TOP), CHRISTOPH HITZ (RIGHT)

Low Rollers Online

5% of respondents to a recent PC Magazine Online poll said online gambling should be banned. Another 59 percent didn't favor a ban but had no interest in trying their luck online, and only 13 percent said they'd like to try; 3 percent said they already had.

Forecast: Meteor Storms

Just weeks after the failure of the Galaxy IV satellite, which knocked out pagers and radio and television feeds across the U.S. on May 19, astronomers at the American Astronomical Society meeting in San Diego reported the possibility of satellite disruption this fall. The culprit: meteor storms.

Earth experiences about a dozen major meteor showers every year, but meteor storms are more rare. The last one was on November 17, 1966, when few satellites were in orbit. Now, however, 500 satellites fill the skies.

Every November, Earth passes through the debris cloud of comet Tempel-Tuttle, producing what are called Leonid meteor events. On November 17, Earth will make its annual trip through the cloud, but scientists are predicting a full-fledged meteor storm. That's because the comet passed close to the sun on February 28, and the heat boiled off small bits of dust and sand.

The danger isn't from the tiny particles that will hit Earth but from their speed of 155,000 miles per hour. If they hit a satellite they can create an electrically charged cloud, called a plasma, which can zap sensitive electronics. The storm is expected to last several days, with the period of greatest intensity lasting 2 to 3 hours.

www.pcmag.com

Complete Notebook Test Results — This issue's cover story on the newest notebooks continues online, with downloadable summaries of features and test results.

Make Yourself Heard in Our Poll — Stop by every Wednesday afternoon or Thursday morning to participate in our weekly online poll.

Have a Laugh With ARF Online — Yes, computing can be funny, and we're proving it with the debut of Abort, Retry, Fail? on the Web.

Second Looks: Your Opinion Counts — You've used the products, now tell us what you really think. We ask for your opinions every Friday.

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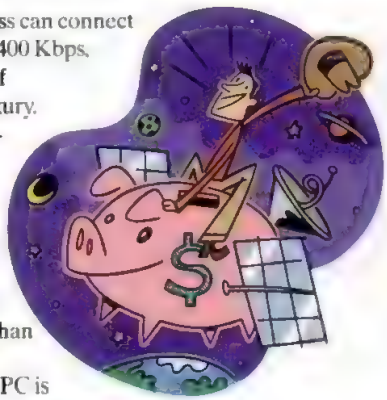
Saddle Up the Satellite



Internet-based satellite access can connect you to the Web at a speedy 400 Kbps, but the steep monthly price of around $130 has made it a luxury. That's changing. Hughes Network Systems recently launched DirecPC, Version 2.0, at the more palatable price tag of $30 for 30 hours a month. That'll buy you Web access 14 times as fast as with 28.8-Kbps service and more than 3 times as fast as with ISDN.

The latest version of DirecPC is designed to simplify everything about personal satellite services, from pricing to installation. The pricing of the first version of DirecPC was confusing, to say the least. For unlimited access at 400 Kbps, it cost $129.95 per month during peak hours and $3.95 per hour for off-peak usage. For $79.95 per month, you could get unlimited Internet access at up to 200 Kbps during peak hours.

Since DirecPC sends data only in one direction—from the Web to your PC—you'll still have to use a phone line to send data back to the Web.

Multimedia Collectibles

Are baseball cards about to go digital? They will if Parable, which has scored a series of important distribution deals for its increasingly popular online multimedia Things, has its way. Some of the Web's biggest names have suddenly embraced this new technology, which has been publicly available only since January.

Using the company's $99 ThingMaker, Web page builders and others can easily create small, amusing multimedia files (Things) that can liven up a Web site with sound and motion. They're viewable via a small browser plug-in called ThingViewer, available at ThingWorld (*www.thingworld.com*) as well as at Lycos (*www.lycos.com*). Now Parable wants to make Things collectible, too.

Parable recently announced a deal with Comedy Central (*www.comedycentral.com*) to offer "South Park" Things to Web-connected viewers of the animated show. "South Park" producers can create Things that promote upcoming shows, and fans can collect the Things, save them in Parable's new ThingCollector, and convert them into screen savers. (Collectors can make copies of Things, along with embedded copyright notices, but they can't alter them.)

Parable has signed additional content deals with the New England Patriots, the Boston Red Sox, and Jones Soda, and it hopes to make bigger inroads into the sports and entertainment markets soon.

ILLUSTRATION BY DAVID BAMUNDO

THIS ISSUE'S CONTRIBUTORS: *Angela Hickman, Carol Levin, Sebastian Rupley, Don Willmott.*

Spy Photos, at Your Fingertips

Can you name the companies that run the world's largest known commercial databases? Sears, Roebuck and Co. has one that's 4.63 terabytes. JC Penney's processes 784 concurrent operations. Wal-Mart Stores' has 50 billion rows of data. And Microsoft TerraServer (*www.terraserver.microsoft.com*) houses over a terabyte of compressed aerial and satellite photos of Earth, making it the largest one on the Web. Built with the help of Aerial Images, Compaq, Legato Systems, the Russian Space Agency, Storage Technology, and the U.S. Geological Survey, the database lets you zoom in to a resolution of 1.5 meters. You can display and print the photos for free or order high-resolution prints for $12.95 to $39.95, depending on the size.

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Top-Selling Retail Notebooks

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2. Toshiba Satellite 305CDS ($1,509)
3. Toshiba Satellite 315CDS ($1,882)
4. Compaq Presario 1622 ($2,249)
5. Compaq Presario 1215 ($1,462)
6. IBM ThinkPad 380D ($1,968)
7. CTX EZBook 772MS ($1,295)
8. Toshiba Satellite 315CDT ($2,305)
9. Compaq Presario 1681 ($2,643)
10. IBM ThinkPad 310ED ($1,386)

Source: ZD Market Intelligence. Data for May 1998.

The $13,000 PC

Even as PC prices plummet, more and more organizations are focusing on total cost of ownership (TCO), which casts the cost of a PC in a whole new light. Market researchers at Gartner Group are out with some eye-opening data on TCO. Their numbers show that on an annual basis, one networked PC costs about $13,200 for support and services. The Gartner study also includes some promising numbers: With new, automated system management tools, ownership costs can be reduced by 15 to 20 percent.

PC Loyalty Ratings

Apple has almost always led in brand loyalty among consumers and home-office buyers. But according to a ZD Market Intelligence survey that examined whether buyers replacing their old PCs were choosing the same brands, Apple fell 10 percentage points from 1996 to 1997, to third place. Gateway inched up 3 points to first place, and HP was up 14 points.

Source: ZD Market Intelligence (Technology User Profile, 1997)

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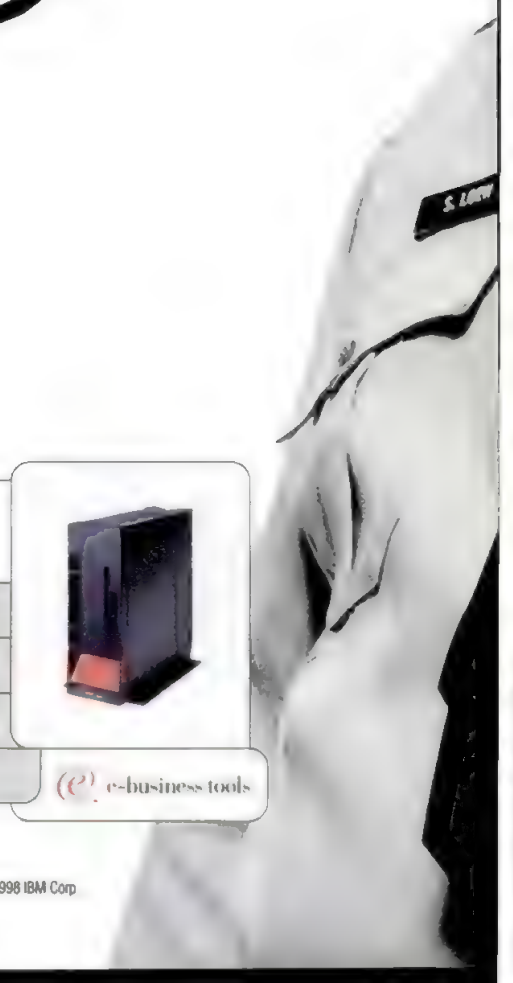

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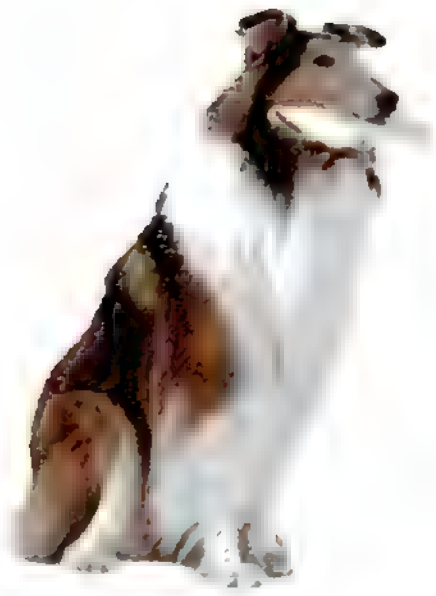

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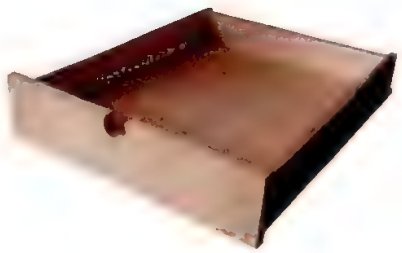

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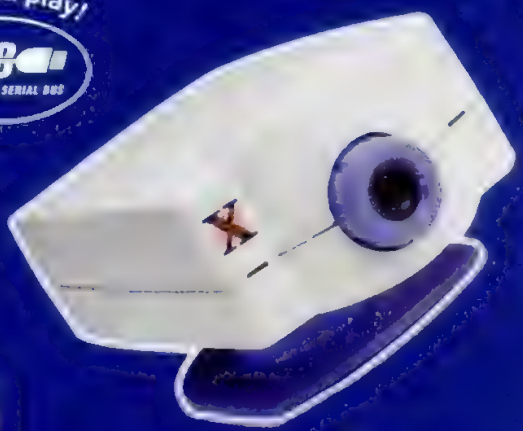

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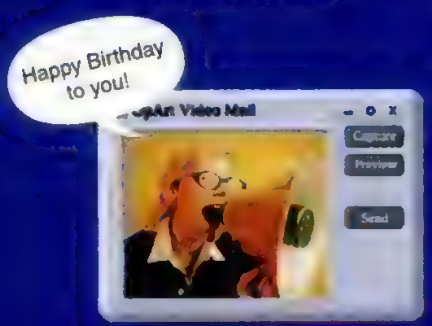

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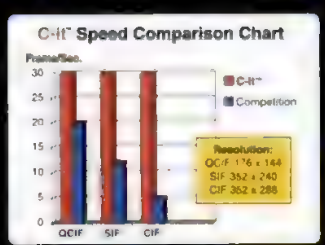

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Letters

THE FUTURE

In the story "PC 2001: Software in the New Millennium" (June 9), in the section titled "Operating Systems," you say: "The best way to conceive of the enormity of a 64-bit address space is to imagine the more than 4 billion bytes of space in a 32-bit address, and then add more than 4 billion bytes to that." More than 8 billion bytes are indeed difficult to imagine. I think that's about 2 bytes for each person in the world. But what you have described is a 33-bit address space, not 64-bit. To imagine what 64-bit addresses are like, imagine that every person on the planet has a PC. Now imagine that each of these PCs has 4GB of memory. Now imagine that all the computers are connected into one overwhelming computer. The combined memory of all of these computers is 64 bits worth of address space. In other words, 64-bit addresses are about 4 billion times 4 billion bytes big.

JIM KELLY
via the Internet

"PC 2001" was intriguing, but it fell somewhat short regarding notebook computers ("Microprocessors"). I was wondering if the three major microprocessor manufacturers besides Intel were concentrating on only the desktop and server markets. As I looked at the chronology chart for processors, it seemed that only Intel was pursuing the notebook market.

CHAD LUCAS
via the Internet

We are all accustomed by now to periodic press reports about someone who has definitively cracked an encryption scheme previously thought to be invincible. I am sorry to be the messenger who announces RSA's demise, but it is my sad duty to do so. The RSA encryption algorithm, as you explain in the "Encryption" section of "PC 2001," is "based on the difficulties of factoring very large prime numbers." Since high school, I have been researching those very difficulties. It turns out that for any very large prime number x, the factors of x are 1 and x.

PETER NORDBERG
via the Internet

CONFUSED ABOUT SPAM

When I read the Trends article "Jettison Your Junk E-Mail" (June 9), I had to laugh, especially at the statement that two of the ISPs already combating spam are EarthLink and HotMail. Almost all the spam that hits my mailbox originates from one of those two ISPs. If they are doing anything at all to block the transmission of spam, it's not evident to me.

DREW ELLIOTT
via the Internet

64-bit addresses are about 4 billion times 4 billion bytes big.

You mentioned that several ISPs are trying to prevent spam by terminating spammers' accounts when they are caught. You talked about an ISP that charges repeat spammers a $1,000 reactivation fee. This won't work. I've never received spam from a valid e-mail address. As a spammer myself, I tend to use free POP accounts that are generally distributed by Geocities or Yahoo. But I never use my own account for that very reason. The free e-mail providers are the ones who need to be controlling the flow of spam, not the ISPs.

MATT REID
via the Internet

This cost-based perspective on spam could be extended to conceive of a versatile system for controlling spam without banning it. E-mail users could set a cost that advertisers would be required to send unsolicited message to their addresses. Costs of approximately 50 cents would discourage unwanted e-mail but not deter advertisements of the type that are now sent by postal mail for similar costs and that many people find worthwhile. An incentive to implement this system is that the money could be distributed to recipients, ISPs or the Federal Treasury.

MICHAEL SEGAL
via the Internet

PRINTING ECONOMICS

In the hardware article "Network Printers" (May 26), you list the estimated cost per page for each printer reviewed. Can you please tell me how you arrived at those numbers?

PANDORA GILBERT
via the Internet

We used cost-per-page figures supplied by the vendors. Their estimates generally include toner and other consumables (such as the drum and fuser oil) but not paper.—Ed.

The network printer reviews were great and almost complete. The major thing you failed to discuss was toner. One of my company's current network color printers was reasonably priced. I was not prepared for the $1,000 bill for the toner, though. Most companies, besides judging the immediate cost of a new printer, must gauge the cost of the full term of the printer's usage.

DEREK K. O'BRIEN
San Diego, California

GETTING PERSONAL WITH ISDN

The article "Personal ISDN Routers" (May 26) states that one ISDN router can be used to share a dial-up ISDN connection among multiple users. The article mentioned that a single registered IP address is required to use the NAT (Network Address Translation) feature in the routers. But the article did not mention that in order to use a single registered IP address, a dedicated ISDN account with a static IP address would likely be required. I have not come across any ISPs (including the ones in the article) that provide a static IP address without a dedicated ISDN account. This dramatically increases the price and complexity of using one of these routers, unless the router is used by one person only, which would defeat the purpose of having an ISDN router.

JAMES MOOTS
via the Internet

I recently purchased a 3Com OfficeConnect ISDN LAN Modem, one of the products you reviewed. Although setup was simple and the unit functioned flawlessly as a hub and router for most applications, two remote-control products necessary for my business wouldn't work with this product. Both Norton pcAnywhere32 and Citrix's WinFrame client crashed within about a minute of launching. 3Com's technical-support staff worked with me for almost three days, even sending me a beta version of the router's flash software, to no avail. Given the 3Com unit's price and features, I was disappointed to have to return it.

BILL DOMAN
Dale, Texas

WHERE'S THE OTHER 1 PERCENT?

In Pipeline ("Pick a Browser, Any Browser," May 26), a question was raised: What is the 1 percent of the browser market that doesn't use Microsoft Internet Explorer or a Netscape product using to access the Internet? The answer is as close as the Letters column in the same issue ("Opera Not Only in Lincoln Cen-

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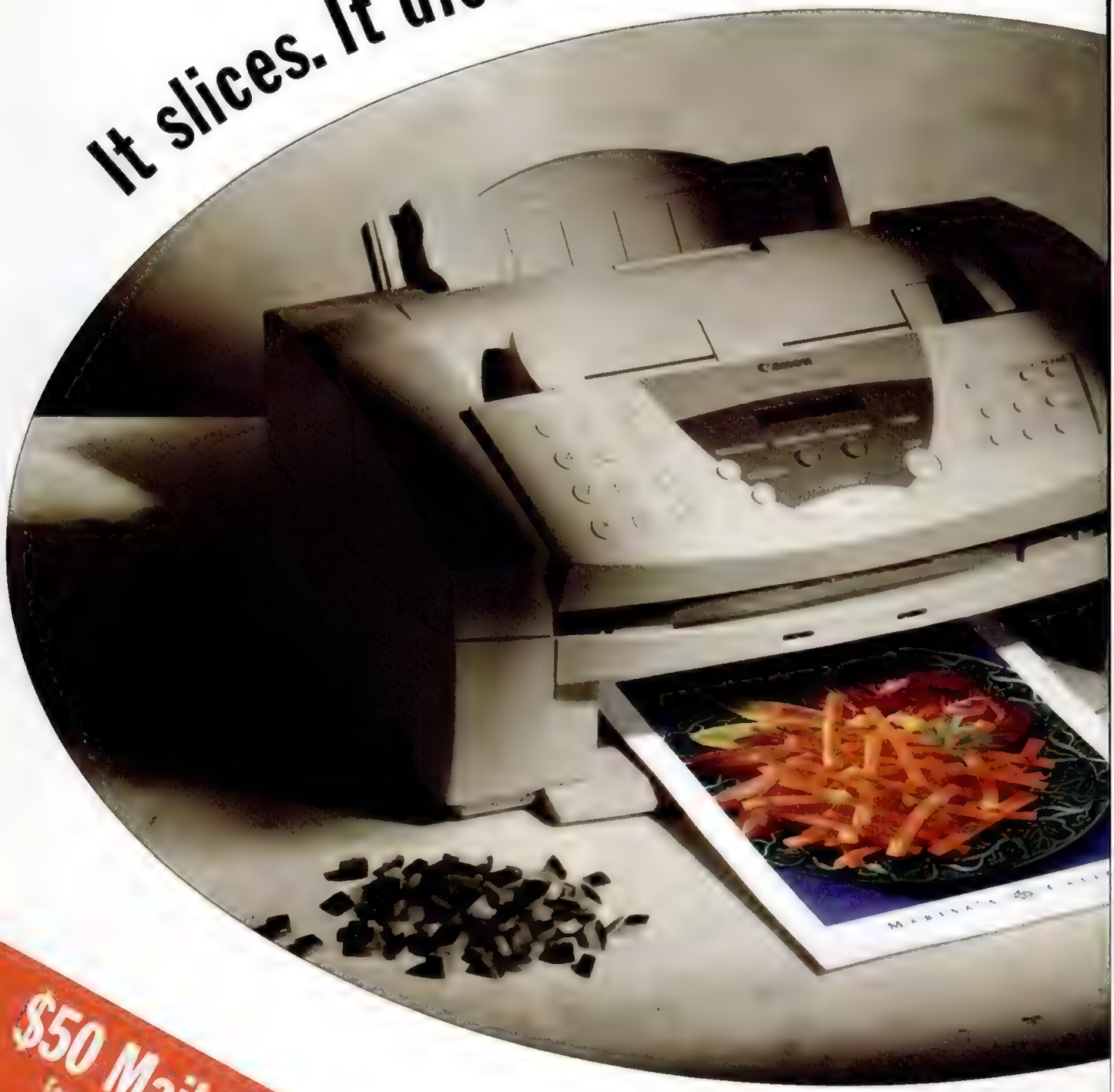

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Letters

ter"). Browsers outside the Microsoft/Netscape circle do exist. Why else would Scott McNealy of Sun Microsystems have testified at the Microsoft antitrust investigation? Most notably, the products include Opera Software's Opera browser and Sun's HotJava browser, both of which are very good products and weigh in at a fraction of the bloated size of the Microsoft and Netscape products.

BRENDEN C. ROEMICH
via the Internet

VIDEO VIA E-MAIL

Your article reviewing the different versions of video e-mail ("Memorable Mail," May 26) seemed incomplete. For example, you didn't include what the quality of the picture would be like on the receiver's end; the file size of a standard message, which would affect upload and download speeds across the Internet; maximum compression size; maximum image size; or whether the products are MPEG-compatible. You also mentioned several features for one product but didn't do so in other reviews of products with those features; for example, you noted that Alaris's product had a test pattern, a countdown timer, and videoconferencing capability, yet you neglected to say whether the other packages had these capabilities. It would also have been nice to see the pros and cons of each of the products listed and which factors went into each product's score.

ELIZABETH STUART
via the Internet

There was no mention of download times. The download time of AVI files is tremendous, whereas a compressed executable file lets the sender and receiver exchange much larger files faster. WorldConnect VisualMail offers up to 600:1 compression with a rate of up to 30 frames per second. Your roundup failed to acknowledge these amazing and cutting-edge technological advances. You should change your rating system to a 10-star system to highlight such visionary pioneering.

BRETT-ELLIS FEREDAY
Las Vegas, Nevada

THE WIDE WORLD OF QUOKKA

As a longtime reader of your magazine and as a sailor, I was pleased to read Jake Kirchner's column on Quokka ("Web Sports: Quokka, Yes; Cosell, No," May 26). I agree that Quokka is doing a fantastic job of presenting sports from the point of view of the participants. I really appreciate knowing what is happening on the Whitbread boats, and this information isn't interesting to me unless it includes details that would be meaningless and impossibly boring to the average person. One of the best features of the Whitbread coverage are the incredibly detailed maps showing the daily positions of each boat and the associated weather. And I get it as it is happening, which is much different from reading a journal after the fact.

BRUCE A. WILCOX
Piedmont, California

A FIREWIRE WAR?

In the last paragraph of Inside Track (June 9), John C. Dvorak talked about 1394 (FireWire) technology and how Microsoft wants PC companies to include it in their systems rather than USB ports. He ended his article stating that he didn't know what Microsoft wants with 1394. To see a computer with FireWire, order a Power Mac from Apple. Apple has already started including FireWire in their computers because most are used for graphics and video, and FireWire gives the fastest transfer rate between digital video cameras and PCs. I only guess that Microsoft wants to take over the video part of the market, on which Apple has an extremely strong hold right now. The only way for Microsoft to get a share of this market is to have PC makers include FireWire in their computers.

JUSTIN GUIDROZ
via the Internet

READ MY LIPS

Jim Seymour's column "Internet Taxes on the Way" (June 9) was a very well written discussion of the Internet, the world of commerce, and the many arms of government. His apparent motive was to educate us about government taxes on commerce. This brings to mind a comparison: the mode of commerce in 1898—walking trails, horses and wagons, and the idea that the world was 20 miles across—with the 1998 world's mode of commerce, in which I can place an order via the Internet and the product will be built half a world away in a few minutes. In 1998, I have to think about a world much larger than the 1898 world and about the need to pay that huge world its fair share of taxes.

JOSEPH SRB, JR.
Columbus, Nebraska

GOOD AND FREE

I downloaded your utility FontViewer ("FontViewer Shows All," PC Tech Utilities, May 26). Thank you for creating and distributing (free of charge) a program that is not only useful but also simple to use and doesn't add strange things to the registry. After I installed and tested FontViewer, I sent e-mail to all of my friends telling them about it and where to download it.

JOHN VAN STEENBURGH
via the Internet

Corrections and Amplifications

In our review of Mission Critical Software's Enterprise Administrator 4.5 ("Marshaling Windows NT Rights," June 9) we incorrectly stated that the product requires you to import users manually. Enterprise Administrator uses Windows NT's native user information and does not require import of user data.

In the June 9 Trends article "Multiuser Accounting," we mistakenly stated that QuickBooks Pro 6.0, the basic version of QuickBooks that lacks support for multiple users, sells for $220 (street). It actually costs $120 (street).

In the May 26 story "400-MHz Pentium II PCs," the following paragraph, second within the "ZD 3D WinMark 98" section in the "Performance Tests" sidebar, should have been included in the "ZD Business Graphics WinMark 98" discussion in the same sidebar:

The nVidia-based cards came in two varieties: two from STB and two from Diamond Multimedia. The two STB Velocity 128 cards, in the Gateway 2000 and Dell systems, edged out the two Diamond Viper 330 cards used in the NEC and Micron PCs. Although they use the same graphics chips, card vendors can engineer their hardware and software differently. Slightly different dot clock speeds and more finely tuned drivers can affect performance. At the same time, however, constant fine tuning of drivers may decrease card stability, leading to operating system crashes and sending users on hunts for new drivers. We suspect that STB has tuned its card and drivers a bit more for performance than Diamond has, enabling the STB cards to score just under 8 percent better than the Diamond cards. Most users would not notice the difference, however.

In the article "Personal ISDN Routers" (May 26), we incorrectly stated that MindSpring offers unlimited 64K access for $26.95. The cost is actually $26.95 a month for 100 64K channel hours, with $1.00 per additional hour.

In the Trends Internet article "Form Factor" (May 26), the phone number for UWI.Com should have been 888-517-2675.

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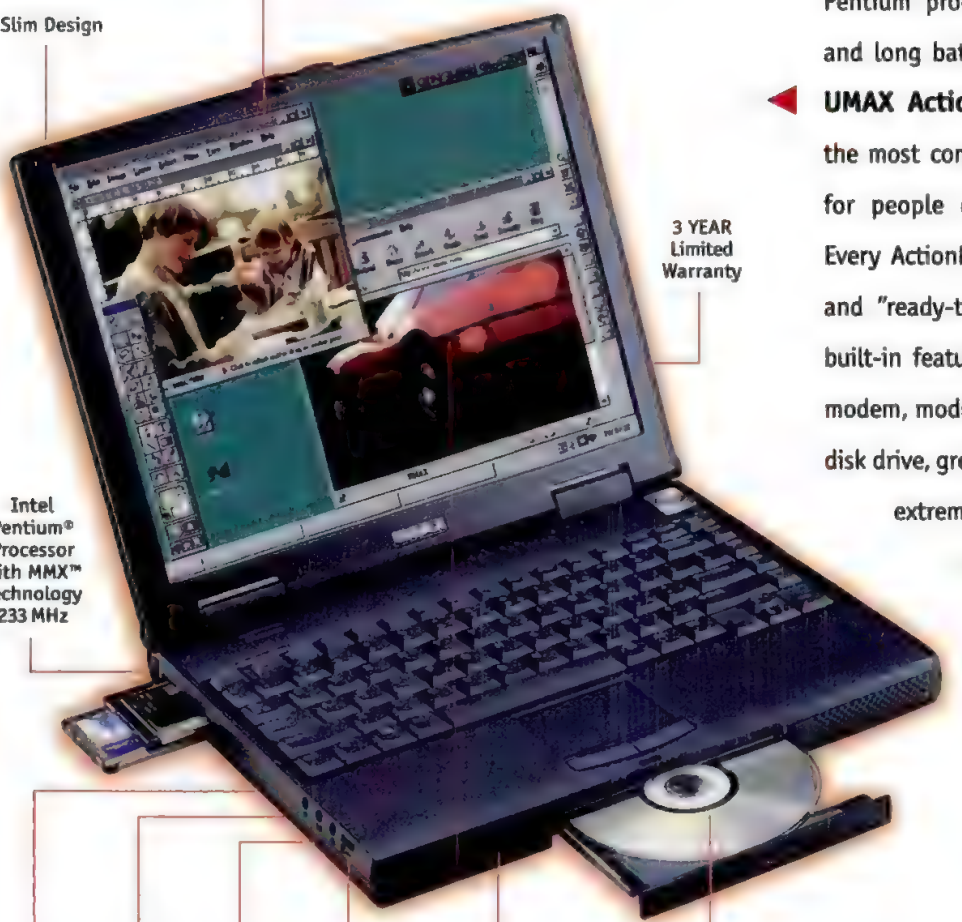

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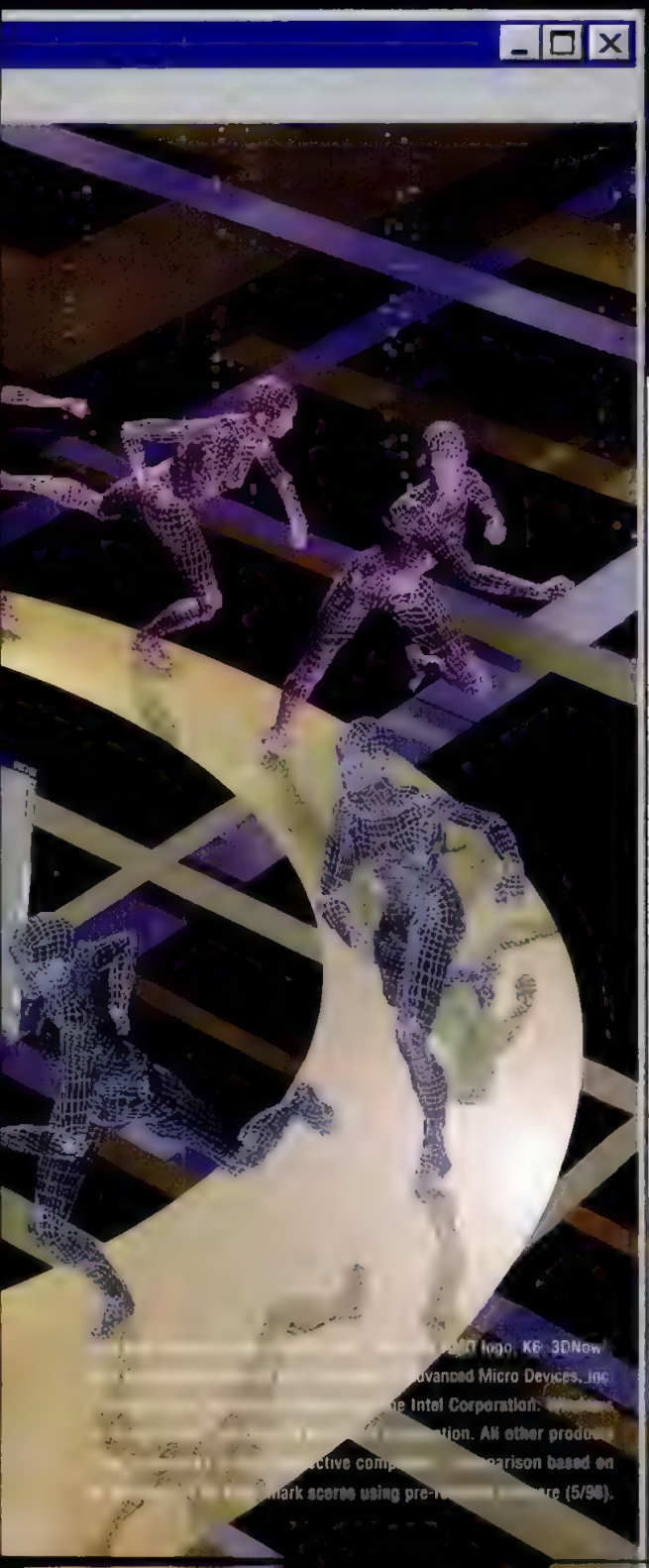

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Trends

Hot Summer for Silicon

Microprocessors now come in more flavors than ever.

This summer has been a particularly active season for the microprocessor market. New instruction sets arrived, while aging platforms faded away. Future chips met delays, while beleaguered chips sought redemption. Some lawsuits came, while others went. And per usual, clock speeds rose, while prices fell.

The comings, goings, comebacks, and setbacks began with AMD unveiling the K6-2 with 3DNow! Technology in late May. It's not only the first AMD chip to use a 100-MHz system bus, but also the first to augment Intel's *x*86 architecture (the de facto standard) with a fresh instruction set. 3DNow! Technology is designed to accelerate floating-point calculation, an important part of 3-D image creation. Though 3D Now! lacks industry-wide recognition, it has garnered support from Microsoft, whose programming interface DirectX 6.0 (due this summer) will enable the development of 3DNow! software.

A day after the K6-2 debut, Intel made an announcement that surprised pundits: It was delaying its 64-bit Merced for six months. That meant the chip wouldn't reach volume production until 2000. So Intel reorganized plans for its upcoming IA-32 processors, which must appease customers as they wait for Merced's IA-64 platform.

Merced will use a connection known as Slot M. In contrast, the original Pentium II desktop chip plugs into Slot 1, and the recently announced Xeon workstation and server chip uses Slot 2.

Before Merced's delay, an upcoming IA-32 chip—code-named Tanner—was to use Slot M and provide an upgrade path to Merced in mid- to late 1999. Now the Tanner name is attached to a 500-MHz chip that will arrive early next year and use Slot 2, which allows for up to 2MB of full-speed secondary cache.

Processor	Release date	Speed*	Type	L2 cache	Cache speed	3-D instructions
AMD K6-2	5/26/98	333 MHz	Socket 7	Off the chip	100 MHz	3DNow!
Intel Pentium II	5/7/97	400 MHz	Slot 1	512K	Half chip speed	None
Intel Celeron	4/15/98	300 MHz	Slot 1	None	———	None
Intel Xeon	6/29/98	400 MHz	Slot 2	2MB maximum	Chip speed	None
Intel Celeron (L2 cache)	4Q 1998	333 MHz	Slot 1	128K	Half chip speed	None
Intel Katmai	1Q 1999	500 MHz	Slot 1	512K	Half chip speed	Katmai
Intel Tanner	1Q 1999	500 MHz	Slot 2	512K	Chip speed	Katmai
Intel Merced	1Q 2000	Unknown	Slot M	Unknown	Unknown	Unknown

* Fastest speed to date

Tanner's chief advance over Xeon will be its use of Katmai New Instructions, a set of 3-D instructions. They'll debut with Katmai, due in the first quarter of 1999. Katmai, for use only with Slot 1, will run at 450 MHz and 500 MHz.

For the market's low end, Intel announced that two new versions of Celeron—a scaled-down incarnation of the Pentium II—will ship late this year rather than early next. Whereas the original 266-MHz Celeron lacked secondary cache, these CPUs (running at 300 MHz and 333 MHz) will each have a 128K cache.

A few days after Intel's IA-32 shake-up—the same morning that the Federal Trade Commission sued Intel for the violation of antitrust laws—an interim Celeron arrived to bridge the gap between the cacheless 266-MHz version and the cache-equipped 300-MHz processor. With this chip, which runs at 300 MHz yet lacks a cache, the company hopes to invigorate a platform that's received lukewarm reviews. Since June also saw the original Pentium approach its last days of production, Celeron will soon carry the market's value end.

SLOT 1 CHIP: TECHNICAL KNOW-HOW

Not to be left out, Cyrix and its parent company, National Semiconductor, made their way into the news as well. Industry insiders were astir when *The Wall Street Journal* reported that National CEO Brian Halla (addressing a Taiwanese trade show audience) had said "that the company will create chips that use an Intel-designed connector known as Slot 1." As it turns out, Halla had simply explained that National knew how to build a Slot 1 chip and had the legal right to sell such a processor.

Though patent cross-licensing agreements made between Intel and National in 1976 were about to expire late last year, Intel extended them in the wake of National's merger with Cyrix. In exchange, National dropped Cyrix's patent suits against Intel.

Microprocessors are coming in ever more flavors as the PC market becomes more and more diversified. Commented Intel executive vice president Paul Otellini recently, "The days when we could just come out with the 386 for workstations, then servers, then desktops, with the 486 coming a couple of years later, are long gone."—*Cade Metz*

ILLUSTRATION BY VICTORIA KANN

Trusty Transactions

A digital vault for Web business.

People trust a signature made with a pen on a sheet of paper but not a digital signature, which consists of 1s and 0s. The idea of managing a 401(k) account over an intranet or transferring money between bank accounts over the Web, without an old-fashioned signature, seems just too risky to many people.

At least that's what IBM's global customers indicated in the company's latest quarterly survey. Security and privacy, they said, remained big concerns in online transactions. IBM and Equifax, a giant provider of consumer and credit information to businesses, are jointly delivering a suite of software and services designed to alleviate these concerns.

The offerings include IBM Vault Registry, which identifies a transaction's parties with a *digital certificate*, or *signature*—software code downloaded to your PC that serves as a unique identifier and that a trusted third party has signed, vouching for your identity. The suite also ensures transactions' privacy through encryption. Equifax is serving as the *certificate authority*—the trusted third party that issues, renews, and revokes certificates.

Rather than providing certificates directly to computer users, the companies will sell digital-certificate services to banks, other financial institutions, and retailers, which will then offer secure-transaction services to their customers. A bank, for instance, could use Vault Registry to let you feel safe opening an account over the Web and accessing your own digital "vault," where you could securely manage your checking, savings, bill payment, and credit card accounts.

Equifax and IBM are aiming squarely at a market that VeriSign now owns, having issued secure server IDs to 500,000 Web sites and provided over 2.5 million personal IDs. VeriSign has also worked with Microsoft, Netscape, and other Web software developers to embed digital-certificate support into millions of browsers and servers. As a result, a company that buys a VeriSign secure server ID gets an instantly deployed base of millions of browsers. This, says marketing director Anil Pereira, gives VeriSign a significant lead over Equifax and IBM.

—Carol Levin

Pentium II Notebooks: Surprise Inside

THE SKINNY ON INTEL'S DESCHUTES PENTIUM II mobile processors was out even before they arrived: You get more power, but you pay in battery life. PC Magazine Labs expected that battery life would be significantly shorter than with Intel's Tillamook Pentium MMX mobile processors. After all, the Deschutes processors draw 6.8 and 7.8 watts of peak power at 233 and 266 MHz, respectively. That's about twice as much as the 233- and 266-MHz Tillamook chips, which draw 3.1 and 4.0 watts respectively. But there's more to the story than meets the eye.

PC Magazine's first tests of Pentium II notebooks seemed to confirm the expectations of short battery life, but in this issue's review of notebooks, we found some surprises. We were expecting about 20 to 40 minutes less battery life with the Pentium II notebooks than with the Pentium MMX systems. Instead, the Pentium II machines' batteries averaged a mere 1 minute less. That's amazing, especially since the higher-powered Pentium II systems came with power-consuming LCD panels that averaged 13.5 inches—half an inch larger than the ones on the Tillamook systems.

To get to the bottom of this mystery, PC Magazine Labs looked beyond the processors' peak power ratings to their average power consumption, as well as to the key power management components—the chip sets and the BIOSes. In this issue's roundup, the Pentium II systems used the Intel 440BX chip set, and the Pentium MMX Tillamook machines most commonly had the Intel 430TX. An advanced chip set can extend battery life by throttling back the CPU, turning off the PCI and AGP clocks, or placing components in a low-power state.

The Pentium II systems' 440BX chip set is fine-tuned for optimal battery life. Unlike the 430TX chip set, the 440BX chip set controls the memory clock for SDRAM. Since a majority of Pentium II systems we tested used SDRAM, they were able to take advantage of this feature, which dynamically puts SDRAM into low-power mode when memory rows are idle.

Battery type and capacity also play large roles in battery performance. Lithium ion offers longer life than nickel hydride (about 5 percent longer among the machines we tested), but it also costs more. Battery capacity was larger in the tested Pentium II notebooks by about 3 percent, which accounted for some of the extra life.

The Pentium II feature that really squeezes out longer battery life is Quick Start. This new mode lets the Pentium II power down to 0.4 watts; the Pentium MMX powers down to 1 watt in the low-power state.

Processor-intensive applications such as a DVD MPEG-2 movie with a software decoder or a 3-D–intensive game keep the processor in high-power mode, but these aren't common notebook applications. ZD BatteryMark runs a script of common business applications interspersed with "think times," when the system sits idle. The scenario allows the processor plenty of time to go into a low-power mode both while the notebook is running applications—even as quickly as in between keystrokes—and during think time.

The combination of Quick Start and the SDRAM memory clock control helps the Pentium II run at a low *average* power that gives it similar battery life to the Pentium MMX while running typical business applications. And that's a big boost for battery life.—*Richard Fisco*

The Lowdown on Battery Rundown

PC Magazine Labs expected notebook battery life to be 20 to 40 minutes less with the Pentium II than with the Pentium MMX. But in our testing, battery life was only slightly shorter.

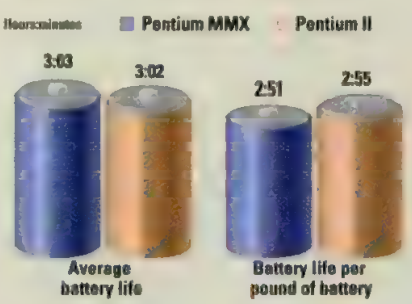

ILLUSTRATION BY LAMBERTO ALVAREZ; PHOTOGRAPHY BY THOM O'CONNOR

Suite Makeovers

XML is poised to bring applications and the Web closer together.

Lotus and Microsoft are ramping up their next-generation suites of productivity applications. This time around, a new form of integration with the Web—based on Extensible Markup Language (XML)—is poised to take applications such as spreadsheets and databases in new directions. Proponents claim that it can revolutionize information exchange between applications and the Web.

Lotus's new SmartSuite Millennium Edition will let you save documents in XML-compliant format. And Microsoft Office 2000, scheduled for delivery early next year, will also build features for XML integration directly into applications.

XML tags, which will be used to locate critical information in Web documents, can be seen as forming a sort of advanced card catalog for a library of Web pages. Although it's nothing more than a way of describing information, the new method has great promise for improving Web search engines and sharing Web-based data with applications software such as spreadsheets and databases. A group of major software vendors, including IBM and Oracle, has submitted a proposal to the Open Management Group to adopt XML as the standard for exchanging data over the Internet.

According to Microsoft executive vice president Steve Ballmer, "We've built HTML/XML publishing directly into the Office applications, so you can save things in HTML format or you can roll things back from a Web page that have been stored in XML format. If you load a chart or a grid back into an [application], for example, the data is back in native Excel format."

Imagine opening up a database software package (such as Microsoft Access) and then, in one step, searching a series of interconnected Web-based databases for a piece of information. Who needs a Web search engine?

According to Microsoft CEO Bill Gates, this kind of database/XML functionality will be dependent on getting new XML database standards in place. These would include specific standards for geographic data and for scheduling databases.

"The goal is for anybody who's got such databases to be able to connect up to other arbitrary databases across the Internet," Gates says.—*Sebastian Rupley*

JAKE KIRCHNER

Finding Strangers in Familiar Places

One day when my daughter was little (perhaps four or five years old), she came into the house, very carefully shut the front door, turned to me with eyes wide, and whispered one chilling word: "Strangers!"

Perplexed, I opened the door to find a nice young couple standing there with confused looks on their faces. New neighbors, they had stopped by to introduce themselves and had tried to strike up a conversation with the cute little girl sitting on the porch. Without a word in response, she had fled into the house. Of course, she had been taught never to speak to strangers. I brought Lauren back outside, introduced her to our new neighbors, and praised her for her earlier caution.

Today I won't congratulate myself too much for being a good parent, because teaching a child to be careful around strangers outside the home is easy. Today I wonder how careful she would have been if the strangers had approached in the guise of Bugs Bunny and Mickey Mouse. The question is not outlandish, because that's exactly the situation millions of children encounter on the Web every day. Hundreds of sites designed for children use favorite cartoon and movie characters to entice them into chat rooms and contest sites. Many of these sites collect personal information from the children in the process.

You may have heard about a new Federal Trade Commission (*www.ftc.gov*) report claiming that when it comes to implementing even the most basic, widely accepted fair information practices, the online industry is doing an abysmal job—in some cases to the point of endangering children. According to the report, of the 212 children's sites the commission surveyed, 89 percent collect information from children that can personally identify them but fewer than 10 percent offer any form of parental control in the process. Not only is the information collected in chat rooms—where unsupervised kids might inadvertently reveal too much about themselves—but at every turn in a visit to a typical kids' site, a child is asked for or required to provide personal data, particularly when registering for contests, surveys, and games.

Decrying "the ability of the online medium to circumvent the traditional gatekeeping role of the parent," the report noted: "Children are told by parents not to talk to strangers whom they meet on the street, but they are given a contrary message by Web sites that encourage them to interact with strangers in their homes via the Web."

The FTC is recommending specific federal legislation that would require Web sites that want to collect personal information to give parents notice and obtain parental consent. For children under the age of 12, the parental consent would have to come before the information could be collected. For older children, parents would have to have the opportunity to insist that information already collected be removed from the site.

I'm not one to believe that federal regulation is usually the best remedy for inadequate self-regulation. But if the FTC report is truly representative of the state of the children's Web site business today, then the industry deserves whatever damage an outraged Congress might wreak on it.

In the meantime, parents should give their children a stern lecture about strangers on the Web. Even teenagers should know the Web can be as dangerous as a city street. Today, Lauren knows that. Does your child?

ILLUSTRATION BY ELLEN WEINSTEIN, PHOTOGRAPHY BY SHONNA VALESKA

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DESKTOP PCs

Celeron's Celestial Heights

After its inaugural 266-MHz Celeron processor encountered a lukewarm reception from both the press and the public, Intel is giving the platform new life by raising the chip's clock speed to 300 MHz.

Celeron is essentially a Pentium II that's been stripped of its secondary cache and cosmetic external casing. Intel's goal with the introduction of this chip is to gain a greater share of the ever-growing value PC market, which has been dependent in large part on Socket 7 chips from Intel competitors AMD and Cyrix. Although Celeron's debut provided manufacturers with an inexpensive path to P6 architecture, the chip failed to perform as well as Socket 7 chips of comparable clock speed, which are typically coupled with 512K of L2 cache.

In addition to such companies as Acer, Hewlett-Packard, IBM, and Sony, industry leaders Compaq Computer Corp. (*800-888-0220, www.compaq.com*) and Dell Computer Corp. (800-999-3355, *www.dell.com*) are now selling 300-MHz Celeron machines.

Compaq opted to introduce the 266-MHz Celeron chip in its Deskpro EP 6266 corporate desktop system. Joining that system is the **Compaq Presario 5020**, which features the 300-MHz Celeron processor. Priced at only $1,299, this consumer mini-tower holds 64MB of RAM, an 8GB hard disk, an ATI 3D Rage LT Pro AGP card, a 32X CD-ROM drive, and a 56.6-Kbps modem. When purchased with either a $299 15-inch monitor or a $179 14-inch monitor—each equipped with stereo speakers—the machine's Sound Blaster–compatible audio card provides Aureal A3D Interactive 360-degree positional sound. USB and MIDI ports are situated in the front of the machine rather than the rear, making it particularly convenient for you to attach peripherals and joysticks. Three bus slots (one PCI, one ISA, and one shared) are available for expansion.

VALUE POWER: *Compaq's Presario 5020 uses the 300-MHz Celeron.*

Dell jumps into the game with the 300-MHz Celeron chip in the **Dell OptiPlex E1**, a business machine for value-conscious users. Dell views this $1,425 system as an affordable upgrade from lingering 386 or 486 PCs or green-screen terminals. Using a low-profile desktop size, the motherboard integrates a number of critical components, including a 3Com 10/100 Wake on LAN card, an ATI Rage IIc AGP graphics controller (with 2MB of memory), and Sound Blaster Pro–compatible sound. The system comes standard with 32MB of SDRAM, a 3.2GB UltraDMA hard disk, and a 32X CD-ROM; the price includes a 17-inch monitor. As with all Dell corporate boxes, the OptiPlex E1 ships with extensive manageability options—as provided by Dell Inspector, a remote DMI application—and three years of on-site service.—*Cade Metz*

DESKTOP PCs

3-D Computing

Intel's 300-MHz Celeron processor isn't the only low-cost chip in town, of course. AMD's latest microprocessor—the K6-2 with 3DNow! Technology—is available at speeds of 266, 300, and 333 MHz and is equipped with a 100-MHz system bus. This is the first chip from an Intel competitor to use a new and unique set of ancillary processor instructions.

The 3DNow! Technology—intended to improve the performance of 3-D software and other applications that rely heavily on floating-point calculation—was designed by AMD with additional input from several software and graphics vendors, including Microsoft. In fact, Microsoft has announced that its forthcoming DirectX 6.0 application programming interface will support 3DNow!, a coup that may facilitate the development of 3DNow! applications later in the year.

NEW DIRECTIONS: *CyberMax now offers the K6-2 CPU from AMD.*

Whereas major PC manufacturers such as Fujitsu and IBM should debut K6-2 machines in the near future, several smaller operations—including CyberMax, Polywell, and TigerDirect—are already using the new chip.

CyberMax Computer (800-443-9868, *www.cybmax.com*), a direct vendor based in Allentown, Pennsylvania, is currently selling two separate K6-2 configurations: the $1,299 **PowerMax K6-2 3D-300** and the $1,699 **Home Theatre K6-2 3D-300**. The former is a 300-MHz standard mini-tower outfitted with 64MB of SDRAM, a 4.3GB hard disk, 512K of secondary cache, an nVidia RIVA 128 graphics card with 4MB of SGRAM, a 32X CD-ROM, and an Ensoniq AudioPCI 32-bit wavetable sound card. The PC's $1,299 price tag also includes two Altec Lansing speakers, a 17-inch monitor, and either an Ethernet card or a 56.6-Kbps modem.

The Home Theatre augments the PowerMax's configuration with a subwoofer and an MPEG-2 decoder card, replaces the CD-ROM with a DVD drive, and offers a 19-inch monitor in lieu of a 17-inch display.

Another long-standing AMD partner, Polywell Computers (800-999-1278, *www.polywell.com*) uses the 300-MHz K6-2 to anchor its $1,295 **Poly K62-300D**. The salient feature of this value system is its hard disk, which spins at 7,200 rpm and offers 9.1GB of storage space. Other major hardware components include 64MB of SDRAM, Yamaha 32-bit 3D sound, Diamond Viper V330 AGP 3-D graphics (4MB of memory), a 32X Toshiba CD-ROM drive, and a 56.6-Kbps modem. Speakers are provided as well, but the monitor is sold separately (a 17-inch display is $299, and a 19-inch is $599).

Miami-based TigerDirect (888-222-5487, *www.tigerdirect.com*) recently announced a 300-MHz K6-2 machine priced at only $999 (direct). The **TigerDirect K-Series 300/3D** backs its K6-2 with 64MB of SDRAM, a 6.4GB UltraDMA hard disk, integrated 128-bit AGP graphics (with 4MB of RAM), and a 32X Max CD-ROM. Even after factoring in the Yamaha-based 3-D wavetable sound card and 56.6-Kbps modem, the system still has three PCI slots and one shared slot available for expansion. Two JBL Media 100 Stereo speakers are included in the system's $999 price, but a monitor is not. TigerDirect bundles a 15-inch monitor with the system for an additional $150. —*Cade Metz*

UTILITIES

The Best of Both Worlds

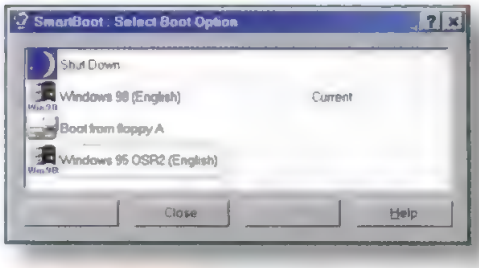
If you're looking for a way to ease into Windows 98 without entirely abandoning Windows 95, check out these new migration utilities from Syncronys Softcorp. (888-999-3800, *www.syncronys.com*) and V Communications (800-648-8226, *www.v-com.com*).

Syncronys's **UpgradeAid 98** ($20 street) should be considered your system's insurance plan during your migration to Windows 98. When you install Windows 98, UpgradeAid's SmartUpgrade tool automatically clones your old OS and stores away files that Windows 98 will change, such as the registry. Even more important, UpgradeAid 98 installs Windows 98 while preserving your existing Windows 95 installation, allowing you access to either operating system.

There's no need to reinstall all your applications to ensure that they work under the new OS, because Windows 98 simply makes a copy of your current registry. Depending on which OS you are working in, SmartBoot loads the appropriate files. With SmartBoot, you can revert to the more familiar Windows 95 environment at any time. Once you are fully comfortable with Windows 98, UpgradeAid will easily uninstall Windows 95, thus freeing up valuable hard disk space.

V Communications offers **System Commander Special Edition for Windows 98.** At $30 (street), this specialized edition of the popular multiboot utility is designed for Windows 95 and Windows 3.1 users that are upgrading to Windows 98. During the installation of System Commander 98, the utility makes copies of critical system files and information. The System Commander 98 boot menu then comes up and prompts you to install Windows 98. The installation wizard guides you through the process of installing Windows 98 on your system and ensures that all of your Windows 95 or 3.1 settings are the same in Windows 98.

Once this is done, you have easy access to all your installed operating systems, and all applications and files have been safely preserved. When you boot your system, the System Commander 98 Boot Menu presents a list of all currently installed operating systems. Just choose the one in which you would like to work, and the program will launch it accordingly. If you decide you want to switch operating systems, you simply reboot your PC.—*Matthew Graven*



AN OUNCE OF PREVENTION: *Synchronys' UpgradeAid 98 offers SmartBoot for choosing your OS.*

REGAP For a complete review of V Communications' System Commander Deluxe and reviews of other multiboot utilities, see "The 1998 Utility Guide" in our issue of March 24, 1998.

UTILITIES

Primed for Windows 98

Now that Windows 98 is here, utility vendors are scrambling to release versions of their products that are optimized for the new operating system.

Network Associates (800-338-8754, *www.nai.com*) has retooled its utility suite for Windows 98. Still offering such useful features as Registry Wizard, Bomb Shelter, Rescue Disk, and WinGauge, **Nuts & Bolts 98** ($50 street) offers a variety of useful new features that will help optimize performance under Windows 98 and 95.

Performance is actually the main focus here. Nuts & Bolts 98 includes a subset of performance-boosting utilities, including Launch Accelerator and Undelete. The Navigational Aids feature tracks which directories and files you use most often. It then adds the directories to File | Open dialog boxes, and the files are added to the Start menu. Nuts & Bolts 98's Quickcopy adds a copy-to function to your right-click options.

For security, Nuts & Bolts 98 still offers McAfee Fortress for encrypting files and e-mail messages. Furthermore, Network Associates has added their Pretty Good Privacy (PGP) technology to Nuts & Bolts 98. The PGP file utility offers public-key encryption for e-mail users.

To protect your system against possible crashes and data loss, Nuts & Bolts 98 includes utilities that can detect and correct problems. For example, PC Checkup diagnoses and repairs many hardware and Windows problems. To prevent data loss during system crashes, Nuts & Bolts 98 offers the Retake feature. Retake backs up your most important files in a special, secure area of the hard disk. When these important files are being edited, Retake updates the backups of these files on the fly. McAfee Image & Restore is also included, allowing you to back up system data that is essential for running Windows.

READY FOR WINDOWS 98: *Use LiveUpdate to make Norton Utilities 3.0 compatible with the new operating system.*

Curious about your system's compatibility with the year 2000? Try Year 2000 Check, which analyzes your hardware and fixes a number of the potential problems the software identifies.

Meanwhile, Symantec Corp. (800-441-7234, *www.symantec.com*) has made available a free patch that will update Norton Utilities 3.0, making it Windows 98–compatible. Since Windows 98 includes the application launch accelerator—which essentially does the same thing as Symantec's SpeedStart Tool—Norton Utilities has shifted its focus by adding an enhanced SpeedDisk tool. This disk defragmenter works closely with the application launch accelerator in Windows 98. To download the patch, you can simply click the LiveUpdate button in Norton Utilities 3.0.

CyberMedia (800-721-7824, *www.cybermedia.com*) is also offering updates for users of Oil Change 97 and First Aid 97. These online updates can be obtained through use of your software's Update button. For users of UnInstaller Deluxe 5.0, CyberMedia is offering a free upgrade to the Windows 98–friendly Version 5.1 (users of earlier versions of UnInstaller can upgrade for $24.95).—*MG*

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SPEAKERS

Digital USB Audio

Thanks to Windows 98's expanded interface support, both high-end and low-end PCs will soon offer full Universal Serial Bus functionality. Speaker vendors are now taking advantage of this opportunity by offering audio systems compatible with USB. Though the speakers function as links in USB's daisy-chain architecture, they also provide a completely digital data path that bypasses the sound card and eliminates distortion associated with conversion to analog format.

RECAP *PC Magazine* tested 12 speaker systems in our issue of January 6, 1998. Editors' Choices were awarded to the Altec Lansing ACS48 and the Cambridge SoundWorks systems.

Altec Lansing Technologies (800-258-3288, *www.altecmm.com*) has two three-piece USB speaker systems available, while Microsoft Corp. (800-426-9400, *www.microsoft.com*) and Labtec (360-896-2000, *www.labtec.com*) are each offering one USB product.

NEAR THE CLAMITE: *Digital speakers from (left to right) Labtec, Microsoft, and Altec Lansing.*

The $149.95 **Altec Lansing ADA70** system includes a 20-watt subwoofer and two 7-watt satellites. The subwoofer has a built-in digital amplifier, a USB port and pass-through, and a set of ordinary PC plugs so you can run it as a standard speaker system attached to your sound card (instead of the USB port). Bundled software features a customizable sound-adjustment interface.

The $199 **Altec Lansing ADA305** system is similar to the ADA70 but has integrated Dolby Pro-Logic surround sound that emanates from the company's side-firing satellite speakers. The subwoofer emits 24 watts of power, and each satellite emits 10 watts.

Coming this fall is the **Microsoft Digital Sound System 80.** An 80-watt, three-piece system with USB and standard controls, Digital Sound, priced at $259, includes a subwoofer built around Philips Electronics' wOOx technology, which aims to provide deep bass and warm sound whether the signal is analog or digital. The bundled software includes a ten-band programmable graphic equalizer.

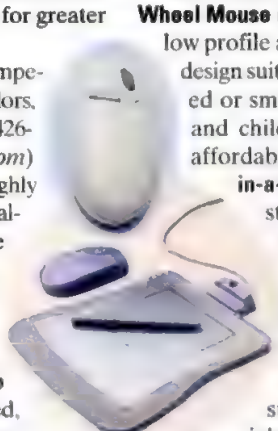
For buyers on a budget, there's the $79.95 **Labtec LCS-1040**, a two-piece, 10-watt USB system with Dynamic Bass Equalization for extending bass response.—*Roderick A. Beltran and Josh Levy*

POINTING DEVICES

Getting Hands-On

If you're still using the mouse that came with your PC, treat yourself to an upgrade. The latest crop of mice, trackballs, and pen tablets offer improved ergonomics and a host of new functions for greater productivity.

After months of competition from other vendors, Microsoft Corp. (800-426-9400, *www.microsoft.com*) has released its first highly contoured, ergonomically designed mouse. The new **Microsoft IntelliMouse Pro** ($75 street) has the familiar scroll wheel embedded between two buttons, but its sloped, right-handed design keeps the hand and forearm aligned in a natural position. The mouse's rubberized lower surface is aimed to reduce the stress of gripping and moving the mouse. New driver features include zooming within Microsoft Office 97 applications and standard wheel-based scrolling in any Windows 95, 98, or NT program.



A FEW POINTERS: *Microsoft's new Wheel Mouse and CalComp's Creation Station.*

The affordable **Microsoft Wheel Mouse** ($35 street), has a low profile and ambidextrous design suitable for left-handed or small-handed adults and children. Even more affordable is the **Mouse-in-a-Box Scroll** ($30 street) from Kensington Technology Group (800-535-4242, *www.kensington.com*). The symmetrical design is suitable for both righties and lefties, and the scroll wheel allows efficient navigation through any Windows application.

Logitech (800-231-7717, *www.logitech.com*) has updated its popular TrackMan Marble trackball. A new scroll wheel is now embedded in the middle button to create the **Logitech TrackMan Marble+** ($80 street). Like its predecessor, the new device is thumb-operated and features Logitech's Marble sensing technology, which detects motion by optically reading dark spots on the ball itself so dirt and grime won't slow it down. The wheel provides scrolling in any Windows application.

Move beyond the world of mice and trackballs with the $129 **Creation Station** pen tablet from CalComp Technology (800-225-2667, *www.calcomp.com*). It includes a 4- by 5-inch tablet that plugs into your PC's serial port, as well as a pressure-sensitive cordless pen and cordless mouse. Both mouse and pen use CalComp's QuickScroll feature, which lets you scroll up and down a page with the touch of a button. The pen's pressure sensitivity lets you create thin or thick lines of greater or lesser opacity simply by pressing it down against the tablet. CalComp also bundles several creativity titles. —*Sharon Nash*

More Big Names Join the Fray

We review 30 projectors in this issue of *PC Magazine* (see "Portable Projectors" for details), but two additional vendors weren't able to send us products in time for testing: Panasonic Presentation Systems (800-528-8601, *www.panasonic.com*) and Eastman Kodak (800-235-6325, *www.kodak.com*).

The 20-pound **Panasonic PT-L795U** is an $8,999 XGA-resolution projector with a rated brightness of 650 ANSI lumens. The unit uses a 280-watt metal halide lamp and features motorized zoom, a wireless remote, and a built-in speaker. Kodak's 9.9-pound **DP 850 Ultra Digital Projector** is priced at $6,499 and offers SVGA-resolution based on DLP technology. With a rated brightness of 500 lumens, the projector has a 270-watt metal halide lamp, a built-in speaker, and a remote-control mouse.—*Adam Asch*

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WEB BROWSERS

Previewing Microsoft IE 5.0

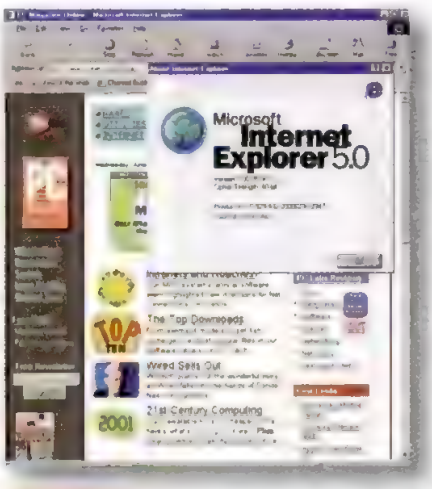
The first "developer preview" of Microsoft Corp.'s **Internet Explorer 5.0** (*www.microsoft.com*) includes features that should help simplify development tasks while helping Web authors make their content more compelling. This very early version of the browser is currently aimed at experienced developers and Web authors only; some features are not yet implemented, and like most early betas, the software is not especially stable.

The current preview is available for 32-bit Windows platforms (95, 98, and NT) as well as Windows NT on Digital's Alpha processor. The standard installation package size for Windows is 15MB to 18MB (which translates to about a 90-minute download via a 33.6-Kbps connection). As with earlier versions of Internet Explorer, IE5 replaces any previous version of the browser that exists on your machine. But it does not modify the operating-system shell during installation.

For the most part, IE5 looks and behaves just like IE4, though some subtle interface improvements lurk just beneath the surface. When you select File | Save As in IE5, you have the option to save a complete Web page—not just the HTML material but all the supporting graphics as well. When you add a page containing multiple frames to your favorites list, IE5 remembers not just the base URL of the frame set but also the specific frames that were loaded within it.

IE5's error messages are more descriptive now and offer clearer suggestions for solutions. The button toolbar is fully customizable and lets you select exactly which buttons appear and in which order. The dialog for organizing your favorites has changed, although as yet it's not clear what direction this feature will be taking. Also new: Internet Explorer 5.0 attempts to integrate audio feedback into the browsing experience by making a faint noise when you click on a link and when a page begins to load.

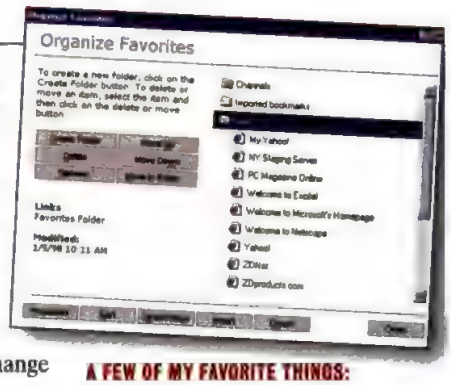
Many of the most significant enhancements found in IE5 will not be directly visible to users. Microsoft says it has adapted the browser's dynamic HTML, CSS (Cascading Style Sheets), and XML (Extensible Markup Language) support to simplify the task of Web developers who want to add dynamic behavior to their pages. Continuing a trend that began in 4.0 browsers, Microsoft is using this release not to introduce new HTML tags but rather to extend the separation of content from presentation and from programmatic behavior. This change should help make sites more maintainable, as well as simplify the task of using newer browser features while maintaining backward compatibility.



NEW DIRECTIONS: *The developer preview of Microsoft Internet Explorer 5.0.*

IE5 allows dynamic HTML code to be encapsulated in external objects that expose properties and methods; a Web page can then call upon the objects by adding a simple CSS "behavior" attribute. (Browsers that don't support the behavior attribute will simply ignore it.) These objects, in turn, can be extended by developers using a simple inheritance model, a capability that has the potential to bring many of the benefits of object-oriented programming into the Web authoring realm.

The program can also maintain the state of objects on a page, so if you leave a page and return to it later, its dynamic components will be in the same condition in which you left them. IE5 permits XML and HTML to be intermixed in a Web page, allowing authors to specify structural information while maintaining a page's ability to be viewed in previous browsers. CSS property values are computed dynamically, and there's support for conditional comments.



A FEW OF MY FAVORITE THINGS: *Organizing your favorite sites.*

IE5 registers a new .HTA (HyperText Application) file extension that launches a browser window with no surrounding browser controls or status bars. Microsoft says customers deploying thin-client, Web-based applications don't want the clutter of the browser controls getting in the way of their interfaces; this feature allows the elimination of those controls simply by changing the extensions of files from .HTM or .HTML to .HTA.

Microsoft will submit the new extensions to the World Wide Web Consortium for standardization. Whether Netscape will adopt them even if they become standards remains to be seen. (As Web authors know, the 4.0 browsers are wildly divergent in their implementations of dynamic HTML.)—*John Clyman*

On Netscape's Horizon: Communicator 5.0

Following on the heels of news about Netscape Communicator 4.5 is the release of the source code for **Netscape Communicator 5.0**. With each of these successive implementations of Communicator, Netscape Communications (*www.netscape.com*) hopes to make the online experience simpler for both Web-surfing novices and experienced users alike.

According to Netscape, Version 5.0 will include an abundance of new features, including improved HTML rendering and full support for PICS (Platform for Internet Content Selection). Also on the docket for Communicator 5.0 is a revamped interface that will add improved customization. The product will also make strides by implementing RDF (Resource Description Framework). When the new interface is combined with RDF technology, you'll be able to browse through content including local spreadsheets and documents from within your browser. This means you can organize Web content and your local files in one centralized place.

Netscape has been consistently criticized for Communicator's Java Virtual Machine. With Communicator 5.0, Netscape is adopting a new strategy. The company is in the process of developing the Open Java VM Interface (OJI), which will allow other Java VMs to work as plug-ins. Though Communicator will still include its own Java VM, users will have the option of choosing a different, third-party Java VM that better suits their needs.—*Matthew Graven*

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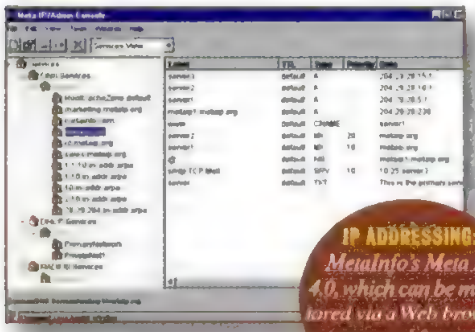
IP MANAGEMENT

Master of Your Domain

Traditionally, IP management programs designed to bring a pool of IP addresses under control were aimed at people administrating tens of thousands of static and dynamic IP addresses. For administrators of smaller networks who were unable to afford the hefty price tags of these products, there was nowhere to turn—until now. Industry leaders MetaInfo (206-674-3700, *www.metainfo.com*) and Quadritek (888-683-2254, *www.quadritek.com*) recently released low-priced packages targeted at small and mid-size business.



IP ADDRESSING: *MetaInfo's Meta IP 4.0, which can be monitored via a Web browser, is targeted for small networks.*

MetaInfo sets its sights on small, single-site networks with **Meta IP 4.0 Standard Edition** (starting at $995 for 500 clients). To ease IP management, MetaInfo includes handy wizards that walk you through establishing Meta's Dynamic DNS and DHCP services, as well as the PNG Multiview Java Manager, which lets you monitor and configure Meta IP through a Web browser.

Along with its new management interface, Version 4.0 introduces SNMP support, which facilitates detailed network reporting, and LDAP support for importing users from any LDAP-based directory. The product's auditing abilities have also been improved, so you can now track individual IP addresses and gather detailed information on each address. Meta IP integrates with most existing database applications, making a separate database unnecessary.

Quadritek is also coming to the aid of smaller businesses with the $495 package **QIPxpress 2.0.** This Windows NT–based program is targeted at networks with less than a thousand nodes. Since such small networks normally do not need a dedicated IP-services support staff, Quadritek designed QIPxpress with ease of use in mind.

QIPxpress is managed through an intuitive Web interface that simplifies basic remote monitoring and the administration of network IP services. The program's flat-file structure means QIPxpress doesn't require a third-party database, unlike higher-end solutions. But that doesn't mean Quadritek is skimping on features: DHCP, DDNS, and BootP services are the same as those of its enterprise-class sibling, QIP. —*Michael N. Rusignuolo*

No Need to Look Back

It may be a harmless prank when someone in the office replaces your desktop wallpaper with something risquè, but it also illustrates how vulnerable most client systems are during business hours. RF IDeas (888-542-4743, *www.rfideas.com*) has come up with a simple but clever way to secure your desktop when you step away from your desk.

ROAMING SECURITY: *Air ID locks down your desktop when the product's radio transceiver cannot detect the radio-enabled ID badge.*

The **$495 Air ID** system consists of an ID badge that communicates with a transceiver, which is connected to a PC's serial port via a two-way radio signal. When a user moves beyond a defined radius, Air ID invokes a secure screen saver until the authorized user returns.

RF IDeas also released an API Developers Kit that will let OEMs, VARs, and large organizations integrate Air ID into existing security and management applications. —*RD*

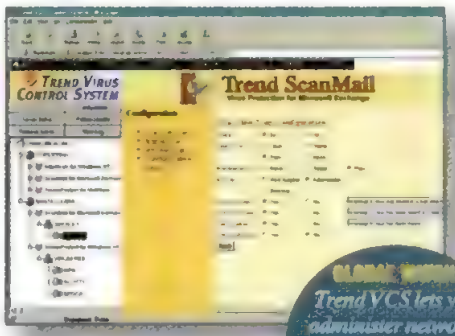
NETWORK ANTIVIRUS

Get Your Network Shots

Protecting your network against computer viruses is just like immunizing the office staff against the season's latest flu strain: It's effective so long as everyone is inoculated. Learning this by observation, two antivirus vendors have added new products to their arsenals that help boost the protection of networks against computer viruses.

Dr Solomon's (888-377-6566, *www.drsolomon.com*) recognizes that almost every network has at least one old PC tucked away somewhere, just waiting to serve as a back door for a computer virus. **Dr Solomon's Management Edition 1.5,** a $599 package, adds support and central administration for Windows 3.1 clients as well as NetWare 3.*x*/4.*x* servers to its already existing support for Windows 95, Windows NT 3.51/4.0, and Windows for Workgroups 3.11.

Until now, Windows 3.1's inability to handle peer-to-peer networking has made remotely installing antivirus software and configuring program updates a difficult proposition. To get around this, Management Edition uses Dr Solomon's Name Provider, which generates a custom computer name for each Windows 3.1 system upon the installation of the software agent. Once a system has a name, you can use this technology to push down antivirus updates and new product configurations.



GLOBAL CONTROL: *Trend VCS lets you administer network-based Trend Micro antivirus applications via a Web browser.*

Trend Micro (800-228-5651, *www.antivirus.com*) has jumped on the Web-based GUI bandwagon with the **Trend Virus Control System** ($3,000 for console and 1,000-user license). The product's HTML management console lets you configure, monitor, and maintain the server-based Trend Micro antivirus applications on your global network from a single seat using an ActiveX- or Java-supported browser.

Using LDAP (if supported) or its proprietary database, Trend VCS stores data that you can use to see trends in virus incidents as well as discover susceptible points in your network. Moreover, the product uses push technology to configure and update the distributed antivirus applications on the fly. You can also configure it to alert you when the number of virus incidents per hour breaches a defined threshold.— *Robert Daly*

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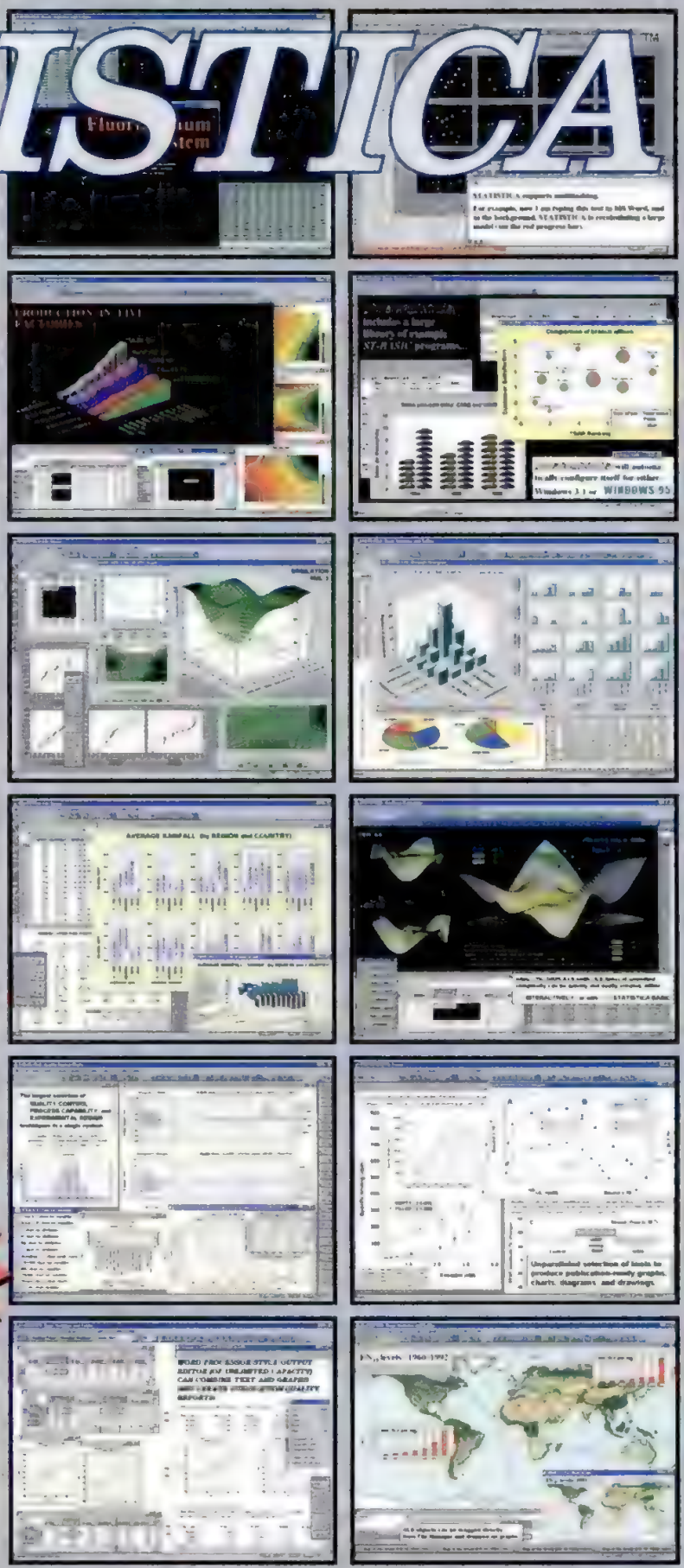

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First Looks

Xeon: The New High End

Intel's new Pentium II Xeon CPU is poised to challenge high-end RISC-based workstations and servers. PC Labs tests first three systems from the market leaders.

By Carol Venezia

If you're a fan of the Intel architecture but think that *x*86 machines just can't cut it against RISC/Unix boxes for high-end workstation and server applications, hang on: You may just have to change your tune with the introduction of Intel's Pentium II Xeon family of processors, whose features have never before been seen in the land of *x*86.

The real story behind this family of processors is not the clock speed (the line launched at 400 MHz). Rather, it's the CPU's new slot, the L2 cache, the new chip sets, and the expanded system memory support that will make the headlines. And justifiably so: The *x*86 architecture has now grown up—and is now approaching the capabilities of the mid- to high-end Unix server.

THE NEW SLOT 2

The Pentium II introduced us to the concept of a CPU mounted on a circuit board, which was placed inside a metal casing and then plugged into the motherboard via an edge connector, much like the connectors you find on PCI or ISA cards (hence the term *SECC*, or *single-edge contact cartridge*). Slot 2 takes that concept one step further: Whereas Slot 1 CPUs each use a 242-contact connector, each Slot 2 processor uses a 330-contact connector. So the familiar black hologram-embossed metal casing surrounding a Slot 2 CPU is just a bit longer than Slot 1 parts.

The significance of Slot 2 isn't in the connection: It's at the second level—Level 2 cache, that is. Unlike Slot 1 Pentium IIs (which talk to their L2 cache at half the CPU's clock speed), Slot 2 Xeon processors talk to L2 at the full clock speed, 400 MHz. This is a huge boon to workstation and server vendors, because applications designed for those platforms are extremely CPU-intensive at the high end. So the faster the processor can access information from the L2 cache, the faster it can crunch your data.

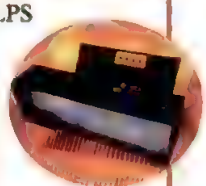
The actual 0.25-micron, 400-MHz Xeon processor core is the same as that of the Pentium II. But to accommodate Xeon's extremely fast L2 cache, Intel had to double the height of the PCB; so the cartridge itself is much taller than the Pentium II's SECC. Xeon will be available in two flavors: One with 512K of L2 cache ($1,124 per part in quantities of 1,000) and one with 1MB of L2 cache ($2,836 per CPU).

INSIDE

PALM POWER: The new HP 660LX palmtop PC comes with 32MB of RAM, and adds a built-in 56K modem, and a color display. For the story, see page 56.

INDEPENDENCE: Macromedia Fireworks' raster and vector tools make it easy for Web designers to manipulate GIF, JPEG, and PNG images. See page 56 for the review.

PHOTO QUALITY: At $500, the ALPS MD-300 is a bargain of a letter-size dye sublimation printer. Turn to page 76 for the review.



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Later this year, a 450-MHz, 2MB L2 cache version will be available for high-end servers.

THE CHIP SETS: 440GX, 450NX

To complement the Xeon processor for both workstations and servers, Intel brings two new chip sets to market: The 440GX AGPset and the 450NX PCIset, for the two respective platforms. Both support a 100-MHz front-side bus, USB (four ports for GX and two for NX), and a south bridge to the ISA bus.

The 440GX AGPset for workstation and midrange servers supports up to two processors, AGP 2x graphics, and up to 2GB of 100-MHz SDRAM. It also supports the Pentium II processor, so PC vendors can migrate PII systems to this new chip set if they so choose. The chip set is a step forward from the 440BX chip set introduced with the Deschutes version of Pentium II, which handled up to 1GB of SDRAM.

But the Xeon party really starts to crank with the 450NX. This chip set comes in two flavors: The 450NX Basic, a five-chip set, and the full-bore 450NX, a nine-chip collection. Both support up to four processors, a 100-MHz front-side bus, and 100-MHz of EDO DRAM.

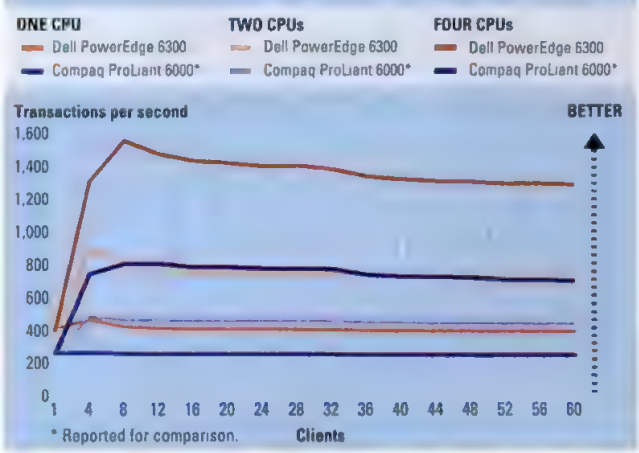
The 450NX Basic—designed for value-priced four-way servers—will support up to two 32-bit PCI buses, plus one 64-bit PCI bus; its maximum memory support is 4GB. By comparison, the 450NX can handle up to four 32-bit PCI buses, up to two 64-bit PCI buses, and up to 8GB of memory. Both use Intel's PSE36, a new 36-bit memory addressing mode that enables memory support above 4GB (up to 8GB with 450NX) and provides headroom for up to 64GB of main memory.

Although Windows NT 5.0 will support the extended addressing feature of the 450NX-based Xeon class systems, a future 64-bit version of NT will be theoretically capable of supporting large physical memory addressing. Also, Intel will soon be providing a software extension of NT 4.0 allowing access to up to 8GB of physical memory when used in concert with 450NX-based systems.

The coolest feature of the 450NX is its built-in cluster support. Server vendors can implement a cluster bridge (for a 90-MHz system bus) that will let end users string multiple Xeon servers together. Clustered systems available later this year will provide failover capabilities for 24-hour, 7-day availability of mission-critical applications, as well as application scaling to levels never seen before on the *x*86 platform. You'll also be seeing eight-way clustered Xeon servers that will use the Profusion architecture (acquired by Intel when it purchased Corollary last year), as well as other proprietary clustering technologies. Xeon is the first Intel processor that can realistically compete in the data center.

SERVERBENCH

To test the capabilities of the Dell PowerEdge 6300 with its four Pentium II Xeon CPUs, we put it up against a Compaq ProLiant 6000 (with four Pentium Pro/200 processors and 512K of integrated L2 cache per CPU). Each server was configured with Windows NT Server 4.0 with Service Pack 3 and 1GB of RAM. The PowerEdge used six 9GB Ultra2 SCSI LVD hard disks hooked to a Dell two-channel RAID controller with a 32MB cache; the ProLiant used six 4.3GB Ultra-Wide SCSI disks connected to a Compaq Smart-2 Array controller with a 4MB cache. Both machines' storage subsystems were configured in RAID 0 arrays for maximum performance. The benefits of having faster processors and a faster L2 cache were evident on our ServerBench tests. At each client-load level and each configuration (one, two, and four CPUs), the Dell PowerEdge cranked through more than half again as many transactions per second as the ProLiant did.



AT THE LEADING EDGE

In our first look at Xeon, we acquired two workstations—one each from Dell and Hewlett-Packard—and one server, also from Dell. The workstations are representative of the wide range of applications for which the Xeon processor will be appropriate. The HP Kayak XU PC Workstation is aimed at the fat of the bat—high-end, 2-D-intensive, CPU-crunching applications such as software development. The Dell Precision WorkStation 610 stakes out the 3-D

2-D PERFORMANCE TESTS

Bold type denotes first place.

	AutoCAD Release 14 Minutes:seconds	Adobe Photoshop Gaussian Blur: 100MB file (minutes:seconds)	Adobe Photoshop Unsharpen Mask: 100MB file (minutes:seconds)	Adobe Photoshop Lighting Effects: 100MB file (minutes:seconds)	Adobe Photoshop Lighting Effects: 30MB file (minutes:seconds)
Dell Precision 610 (1,280-by-1,024, 32-bit color)	1:00	0:34	0:26	4:23	1:19
HP Kayak XU (1,280-by-1,024, 32-bit color)	0:43	0:36	0:33	4:36	1:18
	◀ BETTER	◀ BETTER	◀ BETTER	◀ BETTER	◀ BETTER

On our 2-D applications tests, the Dell Precision WorkStation 610 and the HP Kayak XU PC Workstation performed similarly, even though the Dell unit had the benefit of extra L2 cache. The results are due mainly to graphics accelerators: The HP unit's Elsa GLoria Synergy card (with 8MB SGRAM) excels at 2-D tasks specifically, while the Dell system's Intergraph board is a 3-D powerhouse with adept 2-D capabilities.

On the AutoCAD test—our most taxing 2-D measure—the Kayak finished the test in less than three-quarters the time of the Precision WorkStation. But

3-D PERFORMANCE TESTS

Bold type denotes first place.

	AVS/EXPRESS 2-D and 3-D (frames/sec)	LIGHTWAVE 3D 2-D and 3-D (frames/sec)	Texture MIP Mapping (frames/sec)	4,000 Polygons (frames/sec)	57,000 Polygons (frames/sec)	3D STUDIO MAX* Benchmark 1 (frames/sec)
Dell Precision 610 (1,024-by-768, 32-bit color)	10.1	7.6	1.9	9.6	1.0	37.3
Dell Precision 610 (1,280-by-1,024, 32-bit color)	6.3	5.6	1.8	7.6	1.0	36.9
HP Kayak XU (1,024-by-768, 32-bit color)	7.2	6.3	1.0	5.7	0.8	16.2
	BETTER ▶	BETTER ▶	BETTER ▶	BETTER ▶	BETTER ▶	BETTER ▶

* All scenes in the 3D Studio Max tests were forced to render.

The high-end 3-D graphics-processing capabilities of the Dell Precision WorkStation 610's Intergraph Intense 3D Pro accelerator shone on our 3-D tests. With the combination of its AGP graphics engine/texture processor and its 14-DSP, dedicated PCI geometry accelerator, the Precision WorkStation excelled, particularly on our 3D Studio Max tests, where it turned in frame rates that were in most cases more than twice those of the HP Kayak XU. But considering the

high ground with its Intergraph Intense 3D graphics engine and 1MB L2 Xeons (the Kayak XU uses the 512K L2 Xeon). We test-drove the machines across a range of workstation applications, including Pro/Engineer, AutoCAD, and 3D Studio Max.

Dell's quad-Xeon PowerEdge 6300 represents the true leading edge of *x*86 technology on the server platform. You'll have to read the review for all the details, but believe us, this machine is the most advanced Intel-based server that we've ever seen. Dell will definitely leave the competition scrambling to play catch-up, because at the time of our testing—less than one month before Intel shipped Xeon—Dell was the only vendor that had a Xeon-based server ready to go.

So what's the bottom line? Watch out, RISC: The *x*86 Intel architecture has matured and is ready for some serious action in the enterprise.

Dell Computer Corp.

Dell Precision WorkStation 610

If you're serious about 3-D graphics and want a Windows NT workstation that's fit for the task, you should check out Dell's Precision WorkStation 610. With its dual 1MB L2 cache 400-MHz Pentium II Xeon processors, OpenGL graphics accelerator, and two 18GB 10,000-rpm Ultra2 Wide SCSI drives configured in a RAID 0 array, this machine will chew through your data like nobody's business.

The key component of this system is obviously its graphics card—or, should we say, two graphics cards. The Precision WorkStation uses Intergraph's Intense 3D Pro 3410GT solution, consisting of an AGP card with Intergraph's 3410T graphics engine and texture processor, hooked up to the 3410G PCI geometry accelerator. The total solution provides 16MB of frame-buffer memory, plus 16MB of texture memory (both SDRAM), so double-buffered true color is supported at resolutions up to 1,280 by 1,024. The PCI part of this graphics duo is a dedicated geometry accelerator card that integrates 14 digital signal processors to perform transformation and lighting functions. Overall graphics performance is boosted, because the host CPU is relieved of geometry-calculation duty. Both OpenGL and Heidi graphics libraries are supported.

The second component that plays a starring role in the Precision WorkStation's performance extravaganza is its disk subsystem. Dell has integrated an 80MBps Adaptec 7890 Ultra2 Wide SCSI controller on the motherboard. When you plug in an optional Adaptec ARO-1130C RAIDport 16MB PCI caching disk controller, you can configure your disk subsystem in a RAID array. Our test machine came loaded with two Seagate 18GB 10,000-rpm Ultra2 Wide SCSI Cheetah drives, each configured as three logical volumes in a RAID 0 array.

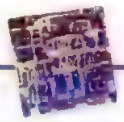
The array is supported on the software side by Adaptec's CI/O Workstation Array Management Software, Version 3.30, which lets you configure your array the way you want it with a few simple mouse clicks. The only gripe we had with the disk subsystem was that it's loud, particularly when accessing data on the drives.

These two key subsystems worked in tandem with the system's two 1MB L2 cache Xeon CPUs to produce awesome performance test results. Not surprisingly—given its 3-D–focused graphics accelerator—the Precision WorkStation produced frame rates on our 3D Studio Max tests that were double or better those of the HP Kayak XU; the Dell machine's Lightwave and AVS/Express scores were also significantly better. On our 2-D–specific Photoshop tests, the Precision WorkStation's timings were a bit faster than the Kayak XU's, although its AutoCAD score was slower.

In line with what we have come to expect from a corporate-oriented Dell system, the Precision WorkStation is well designed and incredibly easy to service. The system's mini-tower chassis houses the requisite floppy disk and CD-ROM drives, plus two empty 5.25-inch drive bays and power and reset switches. Depress the button on the lower left side of the front panel, and the side panel is released for access to interior components.

Inside the box, you'll find an AGP slot, four PCI slots, and one shared slot. Flipping up the power supply—an easy task which requires only pressing a release switch—reveals four DIMM slots, which can accommodate up to 2GB of 100-MHz ECC SDRAM, once 512MB DIMMs are available. There are also plenty of controllers to keep fixed devices happy, one each for Ultra2 SCSI, Ultra-Wide SCSI, and dual-channel UltraDMA/33.

Taking off the front panel reveals the system's drive cage, which can be removed from the chassis simply by unplugging the drive cables and then pulling on the handle. The cage will hold either four 1-inch or a combination of two 1-inch and two 1.6-inch fixed devices. Turn the system around to the back, and you'll



Dell Precision WorkStation 610

Direct price: $15,520 with two 400-MHz, 1MB L2 cache Pentium II Xeon CPUs, 256MB ECC SDRAM, two 18GB Ultra2 Wide SCSI hard disks, Adaptec ARO-1130C PCI RAIDport card with 16MB cache, Intergraph Intense 3D Pro 3410GT graphics card, Windows NT 4.0

Dell Computer Corp., Round Rock, TX, 800-388-8542, 512-338-4400, fax, 800-832-4329
www.dell.com.
414 at www.pcmag.com/infolink

RGB-to-CMYK Conversion: 100MB file (minutes:seconds)	ZD High-End Winstone 98 Score	ZD High-End Graphics WinMark 98 Score	ZD CPUmark$_{32}$ Score
0:25	43.1	182	1,100
0:29	39.1	151	1,394
◀ BETTER	BETTER ▶	BETTER ▶	BETTER ▶

on our Photoshop tests (which are multithreaded and therefore tax both CPUs), the Dell unit's extra half megabyte of cache paid off. For a complete explanation of how we tested, visit our Web site (*www.pcmag.com*), or see "Graphics Workstations" in our issue of February 24, 1998.

Benchmark 6 (frames/sec)	Benchmark 6 (frames/sec)	Benchmark 7 (frames/sec)	PRO/ENGINEER (minutes:seconds)
36.2	30.9	23.7	1:42
34.4	30.3	17.1	1:47
16.2	17.2	6.7	2:22
BETTER ▶	BETTER ▶	BETTER ▶	◀ BETTER

high-end 2-D focus of the Kayak, we did not find these results surprising. For a complete discussion of our testing methodology, visit *www.pcmag.com* or see "High-End Graphics Cards" in our issue of June 30, 1998.

find two USB ports, SCSI-out, jacks for the integrated Sound Blaster–compatible audio, and an RJ-45 jack for the integrated 3Com Wake-on-LAN–enabled Fast Ethernet adapter.

The Precision WorkStation supports Dell's OpenManage 4.2, so it complies with all key industry standards, including DMI, SNMP, and Intel's Wired for Management spec. Further, the machine provides fault-management features such as memory prefailure alerts, temperature sensors, and fan-failure alerting.

For graphics professionals primarily concerned with top-notch 3-D performance, the Dell Precision WorkStation 610 is an excellent solution.

Hewlett-Packard Co.

HP Kayak XU PC Workstation

Demanding 2-D applications that handle financial analysis, software engineering, and CAD call for a workstation that's got the power—at the processor, graphics, and disk levels—to crunch through mountains of data. If you need a Windows NT system that's highly capable of tackling these tasks, the HP Kayak XU PC Workstation may be the machine for you, with its RAID 0 disk subsystem, advanced Permedia 2–based graphics, and dual Xeon processors with 512K L2 cache per CPU.

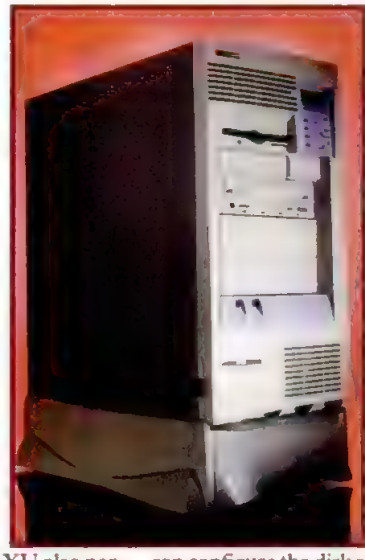
The Kayak XU's graphics subsystem is powered by Elsa's GLoria Synergy 3D OpenGL card with 8MB of synchronous graphics RAM. The key component of this board is 3Dlabs' Permedia 2 accelerator, which combines a 2-D rasterizer, a 3-D rendering engine, and a 3-D geometry setup engine on a single chip. This single-chip solution's performance is on a par with previous accelerators that used both 3Dlabs' Glint 500TX and Glint Delta processors.

Bear in mind that this card is focused on high-end 2-D applications. Unlike the Intergraph Intense 3D board in the Dell workstation (which has a dedicated board for geometry calculations), the Elsa GLoria Synergy is strictly for entry-level 3-D and is not meant for advanced 3-D applications. Although HP recommended we test 3-D applications such as 3D Studio Max in 16-bit color mode, we present performance scores at 1,024-by-768 32-bit color, because the card can handle that resolution and color depth adequately. (Those settings are also a more stressful test case, even though 16-bit color is a reasonable choice for some 2-D workstation applications.)

The 2-D focus of the Kayak XU showed on our performance tests. Even though the Dell system was configured with 1MB L2 Xeons (as opposed to the HP's 512K L2 parts), the HP machine finished our AutoCAD test in two-thirds the time it took the Precision WorkStation to complete the test due to its specialized AutoCAD drivers. The Kayak XU also performed well on our Photoshop tests, which are multithreaded and therefore exercise the capabilities of both processors. On each measure, the HP workstation kept pace with Dell's machine, posting times that were just a few seconds slower—and a second faster in the case of our 30MB floating point-sensitive Lighting Effects test, which fits mostly in system memory.

The Kayak XU's 3-D test scores were another story, however. As we expected, the machine's frame rates on most of our 3D Studio Max tests were less than half those of the Precision WorkStation. The performance gap narrowed slightly on our AVS/Express and Lightwave 3D tests, but if you want an NT workstation specifically to run 3-D software you should choose another graphics board.

As with the Dell unit, another important contributor to the performance of the Kayak XU is its disk subsystem. The machine uses HP's FastRAID technology, which combines an Adaptec ARO-1130CA 16MB PCI caching RAID controller with a motherboard-integrated Adaptec 7880 40-MBps Ultra-Wide SCSI channel. When you plug the board into a PCI slot and plug chained hard disks into the 7880 channel, you can configure the disk subsystem into either a RAID Level 0 or 1 array. In our test system, HP loaded two 4.5GB 10,000-rpm Seagate Cheetah drives, configured in a RAID 0 array.



HP Kayak XU PC Workstation
Street price: $7,500 with two 400-MHz 512K L2 cache Pentium II Xeon CPUs, 256MB ECC SDRAM, two 4.5GB Ultra-Wide SCSI hard disks, HP FastRAID adapter with 16MB cache, Elsa GLoria Synergy graphics card, Windows NT 4.0
Hewlett-Packard Co., Palo Alto, CA, 800-322-4772
www.hp.com
416 at www.pcmag.com/infolink

Like all HP PCs, this Kayak XU is impressively and soundly built and shows off the company's engineering and design expertise. You'll notice first that the Kayak XU's mini-tower chassis is slightly taller than average; that's because it has a pedestal on the bottom to accommodate the power supply. Getting inside the enclosure is easy: Just flip up two levers (one on either side of the case) and pull the cover off.

Once inside, you'll find a well-organized, well-built system that exhibits great attention to detail and ease of servicing. The motherboard is mounted on rails, for easy removal should it require servicing. The hard disks are secured in place with captive thumbscrews, so you won't need a screwdriver to remove or add devices and you won't lose the screws during the process. Another feature unique to the Kayak XU that extends its serviceability appeal even further is HP's MaxiLife technology, which is geared toward ensuring maximum system uptime.

MaxiLife combines an HP-designed ASIC diagnostic controller (integrated on the motherboard) with an LCD status panel mounted on the front of the chassis; you'll know when and if there's a problem at a glance. The MaxiLife controller performs hardware monitoring during the boot process and then checks for any POST errors. Whether the unit is powered on or off, you access the system information through the LCD panel, including BIOS version, serial number, and details on such installed components as processors, memory, and hard disks. If everything's okay, you'll see a happy face on the LCD panel.

Expandability—both inside and out—is another key feature of the Kayak XU. Our test machine featured an HP Wake-On-LAN–capable Fast Ethernet/SCSI ComboCard with both internal and external SCSI connectors. In addition to two free 5.25-inch drive bays plus microphone and headphone jacks, our Kayak XU had an HP CD-Writer Plus 8100 CD-RW drive, so you can burn your own CDs with the aid of the included Adaptec EasyCD Creator software.

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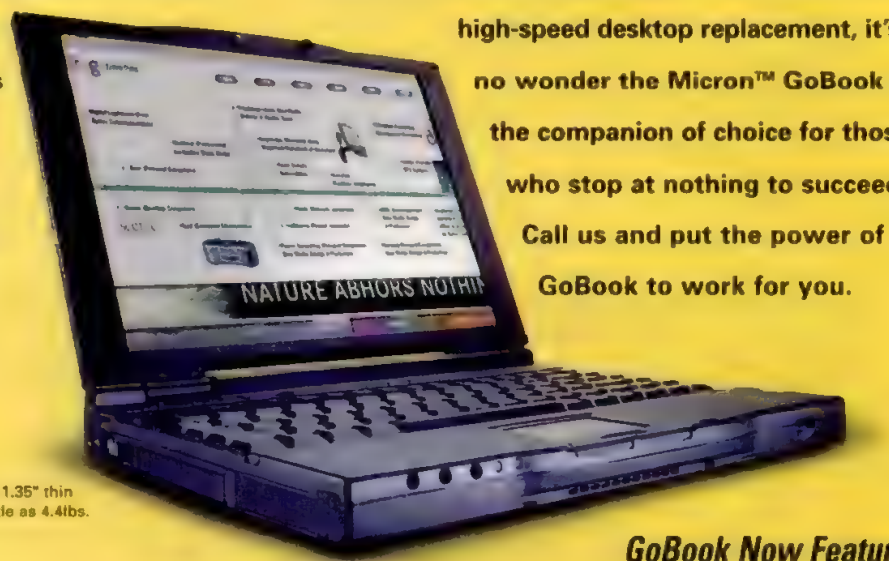

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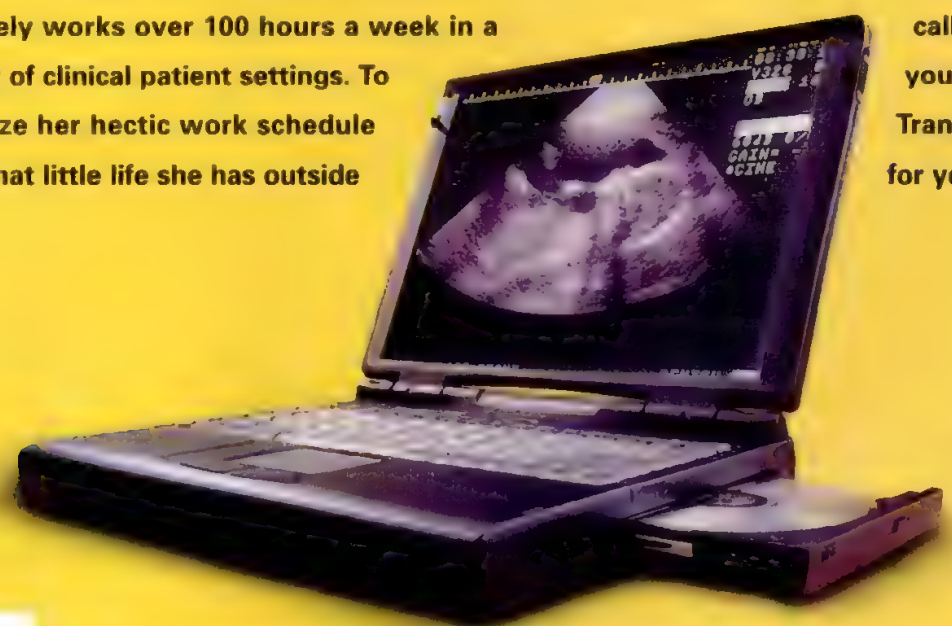

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"The TransPort Trek is the fastest budget notebook we've run through our mill."

- PC World, *Ranked #1, May '98*

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PC World, May '98

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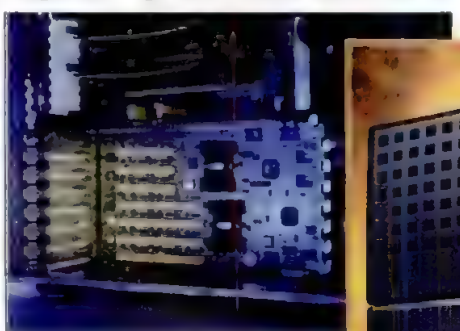
Dell Computer Corp.

Dell PowerEdge 6300

So you think it's impossible to be wowed by a server? You'll change your mind when you see Dell's new PowerEdge 6300. Outfitted in a slick charcoal-gray chassis, the PowerEdge 6300 leverages all of the Pentium II Xeon and 450NX chip set's most salient features to successfully deliver the most progressive Intel-based server that we've seen to date. And with its record-breaking performance, the new PowerEdge is ready to take on your mission-critical, enterprise-class applications.



64 BITS WIDE: *Dell's PowerEdge 6300 server incorporates four 64-bit, hot-plug-ready PCI slots.*

The PowerEdge 6300's case has been completely redesigned from the previous-generation 6000, with rack density in mind. The unit itself (which is more rectangular and elongated in shape than the 6000's boxy chassis) is 7U high, so you can fit six in a rack. Also, the chassis is designed so that you don't need any tools for servicing or swapping out components.

Up front, you'll find six hot-plug, lockable drive bays, which can support either 4GB, 9GB, or 18GB hard disks or up to 108GB of internal, hot-swappable storage. Each hot-plug disk carrier has three visible lights, indicating whether each disk is powered up, active, or has failed.

Inside our test machine's hot-plug disk carriers were loaded six 7,200-rpm 9GB low-voltage differential SCSI drives, hooked up internally to a Dell dual-channel PowerEdge RAID Controller (PERC) with 32MB of cache. Windows NT Server 4.0 was striped across two 4.5GB 10,000-rpm Ultra-Wide SCSI drives (located in the fixed drive bays to the left of the hot-swap cage) and connected to the unit's integrated low-voltage differential SCSI controller. A floppy disk drive and a 24X-maximum CD-ROM drive were also included.

If you want to find this server's most impressive features, you've got to look inside the case. We'll start with the abundance of PCI slots, which you can get to by opening an access hood built into the top cover of the chassis—no tools required. Once inside, you'll find seven hot-plug–ready PCI slots: three 32-bit slots and four 64-bit slots. (When available, NT Server 5.0 will enable the hot-plug part of the equation.) Dell has implemented the 450NX full chip set minus a memory slot to allow for three independent PCI buses: One 64-bit bus for the 64-bit PCI slots, one 32-bit bus for the 32-bit PCI slots, and a second 32-bit bus for integrated controllers (which include two 80-MBps Ultra2 SCSI channels and one Ultra-Narrow channel for devices such as a CD-ROM or a tape-backup drive).

The hot-plug PCI slots all will support hot replacement, expansion, and upgrades. This means that if a card fails, you can replace it with a new one without having to shut the server down—a key feature if you're deploying the PowerEdge 6300 in a enterprise environment. When Windows NT 5.0 ships, Dell will also provide and support slot dividers inside the server to separate installed PCI cards, so if you need to swap out or add a card while the server is running, you won't touch an active card in an adjoining slot. And as an added bonus, all the PCI slots are screwless: To add or remove a card, simply flip back a plastic retainer that's attached to the expansion card bracket.

Dell PowerEdge 6300
Direct price: $38,357 with four 400-MHz Xeon CPUs with 1MB L2 cache, 2GB RAM, two 4.5GB Ultra-Wide hard disks, six 9GB LVD hard disks, Dell PERC with 32MB cache, 24X CD-ROM drive, two Intel Fast Ethernet adapters

Dell Computer Corp., Round Rock, TX, 800-388-8542, 512-338-4400, fax, 800-832-4329, www.dell.com

415 at www.pcmag.com/info/m

To access the PowerEdge 6300's innards, you simply loosen a couple of captive thumbscrews and slide the cover off. Flip that cover over, and you'll find a map of the system board, with details on jumper switch settings as well as a highly detailed system board map. Behind the seven hot-plug PCI slots is a connector for the machine's memory card (RAM is expandable up to 4GB); behind that are the system's four Xeon processors. The entire motherboard is housed in a cage that you can slide out of the chassis in three stages, depending upon what components you have to service. Cabling is labeled on both sides, so you won't misplug a device connector. The PowerEdge 6300 also features redundant power supplies. Each unit ships with three 320-watt load-balancing power supplies; two are needed in order for the server to continue running.

All this heavy-duty hardware really paid off on our ServerBench tests. Compared with a quad-processor Pentium Pro server, the PowerEdge 6300 crunched through nearly double the number of transactions per second in one-, two-, and four-CPU configurations, regardless of the number of clients we threw at it. In fact, the two-way PowerEdge generally performed similarly to the 4-way Proliant across all workloads.

The company ships the PowerEdge 6300 with the HP OpenView Network Node Manager (NNM) Special Edition, which offers basic network management capabilities. Dell's manageability strategy—called OpenManage—is a set of tools, technologies, and partnerships designed to help integrate Dell equipment into an open environment. Specific server tools are provided, and popular enterprise management solutions are supported, including Tivoli for Windows NT and AIX, HP OpenView NNM for UP-UX, HP OpenView NNM for Solaris Netview for AIX.

If you need a powerful server that's easy to service, has plenty of room to expand, integrates forward-looking technology to guard against obsolescence, and complies with standards so it can seamlessly fit into your existing environment, the Dell PowerEdge 6300 is a stellar choice. PC

19-INCH MONITORS

The Long and Short of It

New monitors from Sceptre and ViewSonic give you two reasons to upgrade to a 19-inch model.

By Alfred Poor

When 19-inch monitors appeared for the first time last year, they offered users attractive choices that were priced just a bit higher than 17-inch models but provided almost as much viewable area as 20- and 21-inch displays. The next generation of 19-inch monitors is here, giving buyers even better choices.

The Sceptre D97A ($700 street) and the ViewSonic PS790 ($750 street) are similar in many ways, though there are some key differences. Both have 18-inch diagonal viewable areas and relatively simple feature sets. Both are targeted at the same CAD, graphics, and advanced users.

The two monitors also share similar specifications. The Sceptre model has a 0.26-mm dot pitch, and the ViewSonic monitor is only slightly finer, at 0.25 mm. Both are capable of 1,600-by-1,200–resolution images at a flicker-freezing 76-Hz refresh rate. (At lower resolutions, the maximum refresh rates are higher than you'll need to use.) The monitors have digital controls and both a 15-pin D-sub connector and five BNC coaxial connectors in the back so you can connect to two signal sources.

WEIGHING THE DIFFERENCES

The biggest difference between the two monitors becomes apparent the moment you move the monitors from their shipping boxes to your desktop. The Sceptre is 18.1 by 17.8 by 18.6 inches (HWD), only slightly deeper than some 17-inch monitors. The monitor does tip the scales at a hefty 55 pounds.

By contrast, the ViewSonic is 17.9 by 17.6 by 16.3 inches (HWD)—less deep than the Sceptre (by 2 inches). The two inches can make a difference for cubicle dwellers; a deeper monitor can feel as if it's in your lap as you work. The reduced dimension has an added benefit: The monitor is almost 8 pounds lighter.

The ViewSonic achieves this compression through its new Matsushita picture tube. Most other monitor tubes—including the 19-inch Hitachi tube in the Sceptre—use a 90-degree deflection angle for the electron guns. (Television picture tubes don't need to produce high-resolution images with great accuracy, so the beam can be bent at a much wider angle. This explains why televisions aren't nearly as deep as computer monitors.)

The ViewSonic's tube uses a 100-degree deflection angle, which creates a shorter distance for the electron beam to travel. Thus the beam is smaller by the time it arrives at the shadow mask and phosphors. The reduced depth dimension on the tube means that less material is required, lowering the total weight. On the other hand, accurately controlling the path of the electrons is more difficult—especially in the corners, where the deflection angle is at its greatest.

IMAGE QUALITY

In image quality, the two monitors are closely matched. We used DisplayMate for Windows from Sonera Technologies (800-932-6323, *www.displaymate.com*) to produce the test images to set up and evaluate the monitors' performances.

After installing the INF file for the ViewSonic monitor, the Plug and Play feature automatically centered and sized the image. The on-screen menu controls (which you access through a set of front-panel buttons) are fairly typical, and you also get immediate access to brightness and contrast. Screen geometry of the images was very good, and the screen was stable during regulation tests (which check for size changes when the image content changes). The controls were effective in removing moiré patterns. Colors were vivid, with photographs showing strong reds and blues with fine detail. The only noticeable flaws were that the red beam was misconverged by about a pixel in one corner (with good convergence otherwise), and there was a slight "roping" of thin vertical lines. Overall, the image quality was above average for its class.

The Sceptre monitor needed size and location adjustments after rebooting. The image was also improved through the pincushion and other geometry controls. The adjustments are made via the on-screen menu, using two front-panel discs; making large changes in settings easy. The moiré pattern controls were not as effective as those of the ViewSonic, and while the image misconverged by only about half a pixel in the upper-left and lower-bottom regions, the area of misconvergence was greater on the Sceptre. Also, the monitor showed significant size changes in the screen regulation tests. Otherwise, the image quality was good, and photographic images showed accurate skin tones and fairly well-saturated colors.

One additional significant difference between the two monitors is in their warranty coverage. ViewSonic backs its monitor with a three-year warranty, but Sceptre provides five years of coverage.

Both monitors have attractive features, but a smaller size and better image quality give the ViewSonic a competitive edge that may convince most buyers to pay the small extra cost. If you're looking to step up from a 17-inch model, both provide affordable alternatives, but the ViewSonic will fit in the same space (or less space) as your current monitor.

THE SKINNY: *The ViewSonic (front) takes up less desktop space.*

Sceptre D97A. Street price: $700. Sceptre Technologies Inc., City of Industry, CA; 800-788-2878, 626-369-3698; www.sceptre.com. *412 at www.pcmag.com/infolink.*

ViewSonic PS790. Street price: $750. ViewSonic Corp., Walnut CA; 800-888-8583, 909-869-7976; www.viewsonic.com. *413 at www.pcmag.com/infolink.*

PHOTOGRAPHY BY THOM O'CONNOR

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THe IT DiRECtOR is having heart palpitations in the elevator. He hates giving speeches. In less than an hour he'll be in front of the entire IT department of the company. Rehearsing his speech in his head, he reminds himself not to forget to mention how successful the implementation of the new [1](employee self-service HR application) has been. The CEO will be there, so he also wants to point out that the [2](server consolidation program) and Y2K project are finished and, most importantly, within budget. The elevator doors open. His [3](pager) vibrates. It's an e-mail from his wife. She asks him to remember to pick up a tin of smoked eel on the way home. He bumps into the lead Webmaster in the hall who tells him that they've been able to take on new projects since they have dramatically [4](reduced the backlog) on Website change requests. He makes a mental note to say something in his speech about how well the Web team is doing. He looks down and sees, to his horror, that he's wearing two different color socks.

THE [5](BEST PARTS) OF HIS DAY WERE MADE POSSIBLE BY LOTUS.

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WINDOWS CE PALMTOPS

Faster, More Connected

Hewlett-Packard's newest palmtop PC has 32MB of RAM, a 56K PC Card modem, and a color display.

By Bruce Brown

Hewlett-Packard Co. recently announced a model with upgraded performance in its Windows CE 2.0 H/PC line. The new HP 660LX palmtop PC ($1,000 street) doubles the standard RAM of the HP 620LX (from 16MB to 32MB) and bundles a 56K PC Card modem. (For a review of the HP 620LX, see "The Ultimate Personal Peripheral," March 10, 1998.) The 660LX keeps the 620LX's bright 640-by-240 256-color display, standard docking station, and AC adapter.

The 21.2-ounce 660LX measures 1.4 by 7.8 by 4.1 inches (HWD) and has a gorgeous 6.4-inch-diagonal color screen. A 75-MHz RISC processor powers the H/PC, which also includes 10MB of ROM plus a CompactFlash slot and Type II PC Card slot.

Rated runtime per charge with HP's lithium ion battery is 5 to 6 hours. According to HP, the included 56.6-Kbps WiseCom v.90 PC Card modem reduces battery life to only 3 to 4 hours; but our experience with H/PCs suggests that battery life will drop more significantly. When you insert the modem, a Windows CE message warns you that battery power may not be sufficient for PC Card modems.

The 660LX's increased memory lets you store more applications and documents on the H/PC, but you'll still think twice about entering a lot of data on the 13-mm-pitch keyboard. Larger-format H/PCs have more generous keyboard spacing (and larger displays); they're better suited to typing tasks than the 660LX.

For reviewing and editing data, however, the 660LX may be just right for many users. And it gives you double the storage space of the 620LX, since Windows CE standard applications are stored in ROM.

In addition to the standard Windows CE applications, the 660LX's software bundle includes bFAX Pro, bFind, and Quicken ExpensAble. HP also includes Starfish Software's TrueSync CE, which lets you partner a REX credit card–size PDA with the HP H/PCs to carry contact, task, and schedule data with you wherever you go.

The HP 660LX has an upgraded feature set, signaling both that H/PCs are gaining in capabilities and that the competition in the Windows CE marketplace will bring buyers more features at lower prices.

HP 660LX. Street price: $1,000. Requires: 8MB RAM (12MB for Windows NT), 10MB hard disk space, Microsoft Windows 95 or NT 4.0. Hewlett-Packard Co., Palo Alto, CA; 800-443-1254; www.hp.com/handheld. *408 at www.pcmag.com/infolink.*

GRAPHICS SOFTWARE

Sizzling Web Graphics

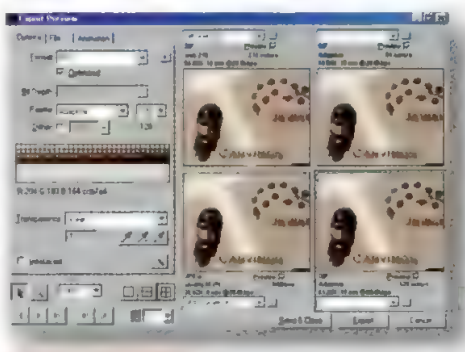
Macromedia's Fireworks will jazz up your site with sophisticated vector drawing and raster imaging tools.

By Luisa Simone

Macromedia's graphics products have pushed the envelope of Web graphics with Shockwave vector and animation formats. But the company's newest offering, Fireworks ($300 street), gets back to basics, concentrating on the most standard Web image formats: GIF, animated GIF, JPEG, and PNG.

Many of Fireworks' core functions can be found in other, well-established products. Specifically, both Fireworks and Photoshop 5.0 offer text and live effects that remain editable. Fireworks, like Deneba's Canvas, combines vector drawing tools (such as those for Bezier curves) with raster imaging tools (such as pixel-selection tools and filter effects).

Fireworks, however, is distinguished by Web-centric functions normally found only in separate utilities. For example, Fireworks can slice a large graphic into separate files and associate each piece with a different URL. Commands that let you *tween* (an animation term for *interpolate*) between two different versions of a symbol and distribute objects across frames make short work of animating GIFs. The program also uses frames to store the various button states (in, out, mouse over, and mouse click) needed for JavaScript rollovers.



CHOOSE YOUR FORMAT: *Fireworks' Export dialog box offers a four-way split preview.*

At output time, Fireworks really sizzles. In addition to standard color reduction and compression options for GIF, JPEG, and PNG formats, you can create an optimized palette where the colors automatically snap to the nearest Web-safe hue. We liked the preview screen, which lets you compare download times and image quality for up to four variations of a picture. Fireworks writes all the HTML code for client/server image maps, the HTML tables to reassemble sliced images in a browser, and the JavaScript code required by JPEG and GIF rollover buttons.

Fireworks offers some hot design functions. These include the ability to render paths with naturalistic brush effects; combine patterned, textured, and gradient fills; and mask elements with a clipping path or alpha channel.

The program has its limitations, though. Its RGB-only environment makes it unsuitable for high-resolution CMYK printed output. And we wish Fireworks could generate a single optimized super-palette for a group of images or bias colors when creating a palette. Very advanced users will bemoan the lack of FlashPix export and Web-based color management. But most Web publishers will find Fireworks' combination of easy-to-edit vector objects and powerful raster output options to be a real productivity boost.

Macromedia Fireworks. Street price: $300. Requires: 32MB RAM (40MB for NT), 60MB hard disk space, Microsoft Windows 95 or NT 4.0 (with Service Pack 3) or later. Macromedia Inc., San Francisco; 800-457-1774, 415-252-2000. www.macromedia.com. *409 at www.pcmag.com/infolink.*

PHOTOGRAPHY BY THOM O'CONNOR

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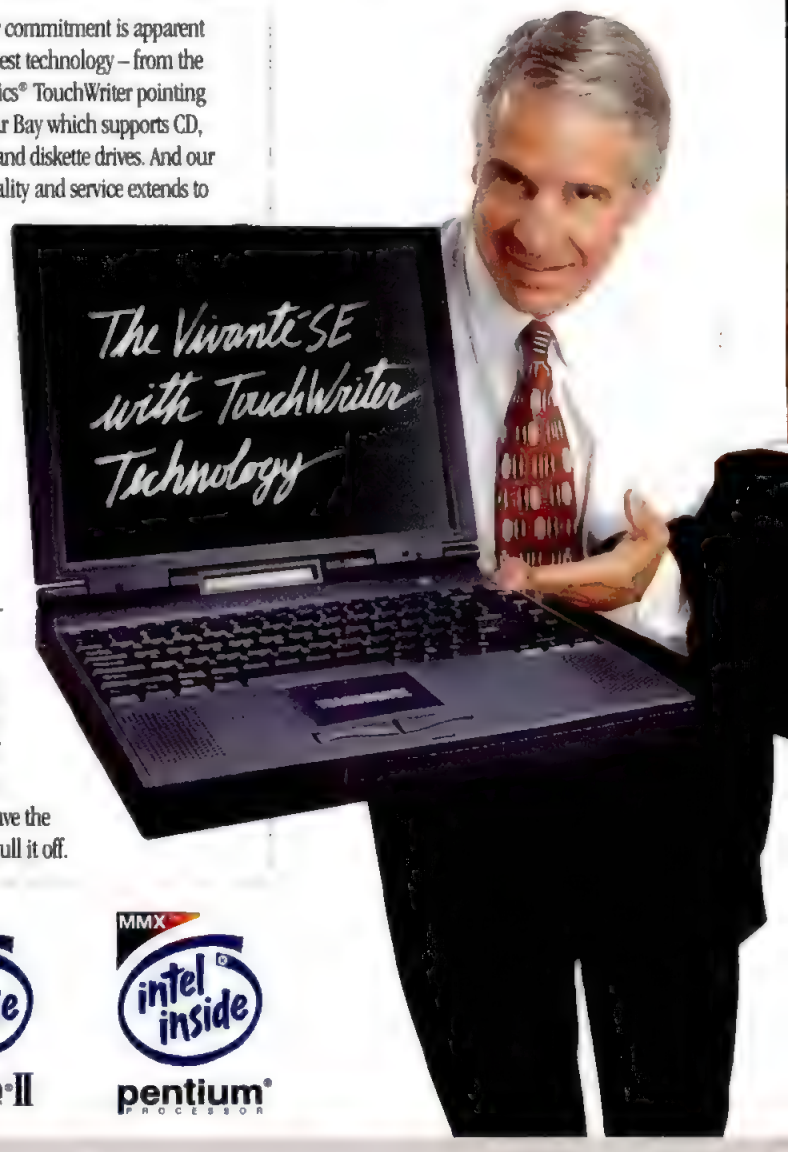

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DOCUMENT MANAGEMENT SOFTWARE

Paper Shredders

Three new versions of popular document managers help you get the most out of your scanner.

By David Haskin

With scanner prices plunging to bargain-basement levels, virtually anybody can now convert paper documents to digital ones. The trick, however, is gathering, storing, and retrieving this wealth of information efficiently.

Three newly upgraded software products—Imaging for Windows Professional Edition 2.0 ($89 list for one seat), Pagis Pro 2.0 ($99 list), and Presto! PageManager 98 ($79.95 list)—simplify the scanning process and perform a host of other tricks.

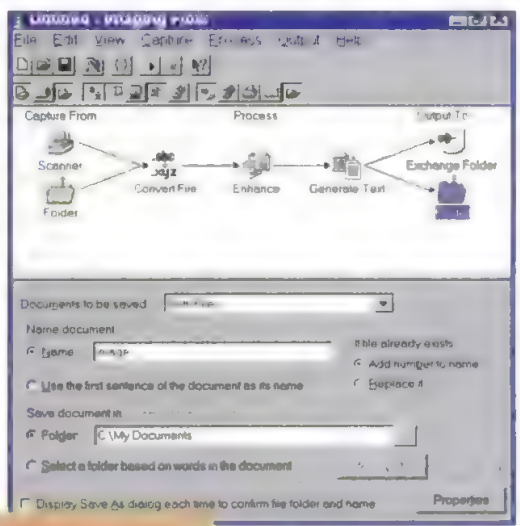
At their core, however, the programs are information managers that help you efficiently store and retrieve scanned text and images. To do this, they provide tools such as customized folders, indexing, and keywords. In addition, they include optical character recognition (OCR) software to convert scanned pages into editable text.

Missing from this group is one of the leaders in this category, Visioneer's PaperPort Deluxe, an Editors' Choice in our last document management roundup ("Taming the Paper Tiger," November 4, 1997). Visioneer hasn't released a major upgrade since that roundup, but the company should feel flattered by how its product has been imitated. Pagis Pro and PageManager 98 have both recast their interfaces to resemble the comprehensive yet simple-to-use PaperPort. Thinkstream's Scan-O-matic, Version 1.1, was released in March, but since it didn't add any substantive new capabilities, we didn't include it in this roundup.

IMAGING FOR WINDOWS

Eastman Software Imaging for Windows Professional Edition 2.0 is the most adept program here at automating the document input process, but it's the least useful for managing documents afterward.

The focal point of this program is its Imaging application, a rudimentary image editor from which you can initiate scans and add basic annotations and text to images. You also can click on a toolbar button to activate the OCR software and insert the file into Microsoft Word or into an HTML file. Like Pagis Pro, Imaging for Windows burrows itself into Windows Explorer. When you right-click on a scanned image in Explorer, you can convert, print, or simply view the file.



GO WITH THE FLOW: *Imaging for Windows' flows are easy to create in the flow editor. They automate complex sequences, beginning with input and ending with output to various sources such as e-mail.*

The true heart of Imaging for Windows—and the part that its competitors can't match—is its *flows*. The simple-to-build scripts automate complex series of processes beginning with input. For instance, a flow can start by scanning a document or, new in this version, by monitoring a specific folder for newly added documents. Among other actions, the flow can then automatically convert the file to another file format, perform OCR, or save the file to a specific folder and e-mail the results to a group of people. Or the flow can automatically print or fax the document.

Although a flow's actions can be complex, nontechnical users can easily create them in the Flow applet either with a wizard or by clicking on toolbar buttons to add steps. Each step, such as acquiring the document from the scanner, then appears as an icon in a flowchart. If you click on an icon, you can modify the step (for example, selecting the specific folder in which to save the output) in the pane below.

In this new version, you can select variables for flow elements from a dialog box, such as instructing the flow to add the file name and creation date as keywords. Other new flow elements enable you to save documents to a Microsoft Exchange public folder and to load external programs, which means IT managers can tap a flow into a custom application.

Missing from the program, however, is the ability to categorize and retrieve documents systematically. It has no specific inbox for just-scanned documents or indexing for retrieval based on a document's contents. For that, you must purchase and install a separate indexing engine and call it with a flow. Nor does Imaging for Windows mask your scanner's regular Twain driver, as Pagis Pro does. Another gripe: It can save files only in TIFF, AWD, and BMP formats, not in other popular formats such as GIF and JPEG.

Imaging for Windows' flows make it ideal for scanning lots of documents. Its lack of built-in indexing and other management capabilities, however, means that this isn't the best choice for individual users who must manage and retrieve information after scanning.

Eastman Software Imaging for Windows Professional Edition 2.0. List price: $89 for one seat. Requires: 16MB RAM, 30MB hard disk space, Microsoft Windows 95, 98, or NT 4.0 or later. Eastman Software, Billerica, MA; 888-242-3518, 978-967-8000; www.eastmansoftware.com. *400 at www.pcmag.com/infolink.*

PAGIS PRO 2.0

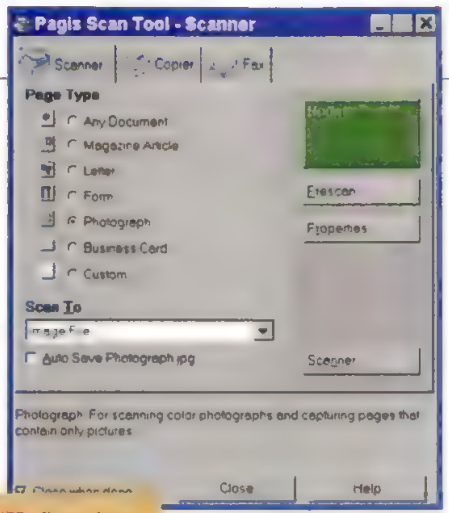
Pagis Pro 2.0 has so many overlapping applications that at first you might not know which one to use. After the initial confusion passes, though, you'll find a deep, rich program for obtaining and managing images and text-based documents.

One way to acquire documents is through Pagis Pro's Scan Tool application, a small dialog box with three tabs that replaces your standard Twain scanning interface. One tab is for scanning and saving documents to disk, another is for copying documents to your printer, and the third is for faxing via your fax modem. The tabs have extensive options, including setting scanning resolution, color depth, and brightness; automatically deskewing crookedly scanned pages; and saving documents in a specified folder.

The most noticeable enhancement in this upgrade, however, is in the Pagis Inbox, to which, by default, Pagis Pro saves scanned documents. Previ-

ously, it was little more than an unadorned folder that you could access from Windows Explorer. It is still an Explorer folder, but it now resembles PageManager 98's Inbox, with the ability to display thumbnail images of documents.

Also like that of PageManager 98, Pagis Pro's Inbox has application icons at the bottom of the window to which you can drag documents. This process either opens the image in the selected application or performs OCR and inserts text. A wizard is available for adding new applications.



PRO POWER: *Pagis Pro's Scan Tool replaces your scanner's Twain interface and provides a deep set of capabilities.*

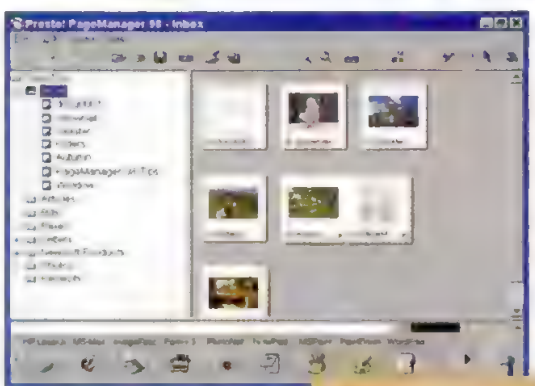
Since Pagis Pro's Inbox is a bona fide Explorer window, though, you can easily view other drives and folders in the Inbox, making it easy to copy and move files. You also can scan a page into any folder on your hard disk, a feature unique to this program. When using Windows Explorer, right-clicking on documents stored in a folder lets you perform tasks such as converting the files to another format and performing OCR.

Two other applications for accessing Pagis Pro's capabilities are the Pagis SendTo bar and Toolbar. The SendTo bar mimics the applications at the bottom of the Inbox—you can drag files to it from Windows Explorer. The Toolbar has buttons for basic Pagis Pro tasks like scanning, copying, and faxing. Also included are Pagis Editor, a rudimentary image editor from which you can initiate scans, and a full version of MGI PhotoSuite for more serious photo editing.

Another Pagis Pro virtue is that it indexes documents wherever they are on your system. By contrast, Imaging for Windows doesn't index at all, and PageManager 98 indexes items only in its Inbox. Also unlike its competitors, Pagis Pro supports complex Boolean searches. These features make Pagis Pro the most powerful document manager in this roundup.

Although Pagis Pro has a multitude of different interfaces from which to choose, we found all of them simple to use. Behind this simplicity and flexibility, however, is a wealth of power that makes Pagis Pro the most useful program in this group for gathering and managing all your documents—not just those you scan.

Pagis Pro 2.0. List price: $99. Requires: 24MB RAM, 58MB hard disk space, Microsoft Windows 95, 98, or NT 4.0 or later. Scansoft Inc., Peabody, MA; 888-295-0682, 978-977-2000; www.pagis.com. *401 at www.pcmag.com/infolink.*



VOILA!: *PageManager 98's Inbox is a Windows Explorer–like interface for storing scanned documents.*

PRESTO! PAGEMANAGER 98

Although Presto! PageManager 98 looks like Visioneer's PaperPort, it adds some interesting and potentially useful twists. We reviewed the Presto! Page Manager 98 Gold Edition, which includes Presto! PageManager, Presto! ImageFolio image-editing program, and Presto! Forms for filling out scanned forms.

Like PaperPort (and Pagis Pro), PageManager 98's main interface is its Inbox, which shows folders in one pane and thumbnails of scanned documents in another. You can view a full-size image by double-clicking on the thumbnail. When you do that, a toolbar appears with tools for annotating the image, such as adding text or highlighting.

At the bottom of the Inbox are icons representing your installed applications. If you drag a thumbnail to an icon, it automatically opens that program and inserts the document (performing OCR first if it's a text document). The program adds the icons by scanning your system during installation for more than 100 popular applications. If you have an application that PageManager 98 doesn't recognize, you can use a wizard to create your own link. You set parameters as part of the link, such as whether PageManager 98 performs OCR before it opens the application.

Consumers, not business users, are most likely to appreciate PageManager 98's most unique features. For instance, it can download images directly from PhotoNet, a commercial Web service that stores your developed photographic prints. PageManager 98's Wrapper feature automatically compresses documents you select into an executable file with an image viewer. That means you can easily e-mail multiple images in virtually any popular image format, and the recipient can view them. Wrapper works automatically if you drag the thumbnails to supported e-mail programs, such as Microsoft Exchange and Eudora Pro 3.0 (PageManager 98 doesn't yet support Microsoft Outlook 97, Outlook 98, or Eudora Pro 4.0).

Like Pagis Pro, PageManager 98 can hide your scanner's Twain interface, but it doesn't provide its own for controlling items such as color and brightness. To set items such as scanning brightness, you must dive into PageManager 98's interface. Even then, it doesn't provide the wealth of options that Pagis Pro does.

Because of these shortcomings, such tasks as printing scanned documents require separate steps for fine-tuning, scanning, and printing instead of one step, as with Pagis Pro. Another annoyance is that PageManager 98 doesn't automatically index scanned documents. Instead, you first must select a menu option to perform OCR. Also, though it supports fuzzy searching, you can perform simple Boolean queries only.

PageManager 98's shortcomings indicate that it isn't as suitable for the business environment as Pagis Pro. But the Wrapper feature and self-explanatory interface make the product a good choice for home use or for those who regularly share scanned documents.

Presto! PageManager 98 Gold Edition. List price: $79.95. Requires: 16MB RAM, 100MB hard disk space, Microsoft Windows 95 or NT 4.0 or later. NewSoft Inc., Fremont, CA; 800-436-4365, 510-445-8600; www.newsoftinc.com. *402 at www.pcmag.com/infolink.*

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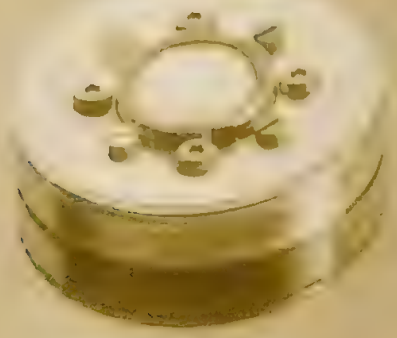

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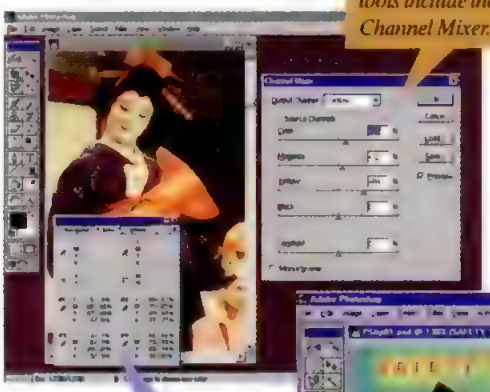
IMAGE-EDITING SOFTWARE

You Asked For It

The latest version of Adobe Photoshop incorporates users' most requested features.

By Luisa Simone

Both in terms of market share and a robust feature set, Adobe Photoshop is the leading image-editing program in the industry. But until now, important and oft-requested functions, such as multiple levels of undo/redo and editable text, have been missing. By adding these and a host of other improvements to Photoshop 5.0 ($650 street), Adobe has infused an old product with new life.



Photoshop's new, more powerful color adjustment tools include the Channel Mixer.

The History palette lets you revert to an earlier edit.

Color Samplers provide instant-feedback color adjustments by displaying both before and after values.

Photoshop 5.0's new layer effects add drop shadows, bevels, embossings, and glows.

MAKING HISTORY

Instead of conventional Undo and Redo commands, Photoshop 5.0's History palette provides a list of your most recent editing changes. With a click of the mouse you can undo (or redo) multiple edits. Convenience aside, the History palette offers powerful ancillary functions. At any point, you can take a snapshot of the current state of your image and then compare different versions.

You can also use the History Brush to merge two versions of an image selectively. Where the History palette lets you reverse an edit, the new text and effects layers let you easily revise an edit, because they remain editable. So even after you've created text, you can once again invoke its associated dialog box and change the copy or formatting. The ability to apply attributes (such as font, size, kerning, tracking, and baseline shift) to individually selected characters within a larger text block means that you can easily create more complex type designs.

Layer effects, which automate the creation of bevels, drop shadows, glows, and embossings, are similarly editable. A double click on the effects icon in the Layer palette opens the dialog box where you can alter parameters, such as the color of a glow. The effect remains totally live and is automatically applied to any new image data you may subsequently add.

One of the more spectacular new features in Photoshop 5.0 is the 3D Transform filter. In simple terms, this filter lets you wrap 2-D image data—such as a scan of a suitcase or toy block—onto a 3-D wireframe model, which can then be rotated in true *x, y, z* space. Though the filter does an amazing job of interpolating data as it moves pixels around in "space," it does have limitations: It can't create image data that doesn't exist, such as the back of an object. And it works best with images that correspond closely to the regular and symmetrical wireframes of a rectangle, cylinder, or sphere. That said, illustrators combining images with slightly mismatched perspectives will find this an invaluable tool.

TOOLS YOU CAN USE

Every Photoshop user will appreciate the new Magnetic Pen and Magnetic Lasso tools. The tools automatically detect the edge of an image, allowing a Bezier curve or selection marquee to snap into the correct position. We found the tools accurate for a wide variety of images, providing that we properly adjusted the configuration options for things like control-point frequency and edge contrast. The one exception was the Magnetic Pen tool, which didn't place enough anchor points in low-resolution images containing subtle curves.

We were also impressed with the way Photoshop leverages both new and existing tools. For example, in its default mode the Measure tool functions like a virtual measuring tape, but a simple Alt-key option turns it into a protractor to measure angles. The Free Transform function now lets you resize, rotate, move, and skew Bezier paths and selection areas as well as image data. Most impressively, the Color Samplers let you inspect the color values of up to four points simultaneously. The statistics, which appear in an expanded Info palette, are updated automatically.

Photoshop has always been adept at analyzing and adjusting color values. Version 5 adds powerful new features that include true spot-color channels, the ability to edit 48- and 64-bit images, numeric input in the Curves dialog box, and previews of Duotone and Index Color mode changes.

The Channel Mixer mimics traditional prepress operations and lets you perform color corrections by combining data from multiple channels. Photoshop 5.0 also takes the plunge into a color-managed workflow: It can read and write ICC tags in images. Photoshop will also turn over the job of color conversion to any other color-management engine. Hard-core traditionalists, however, can continue to use Photoshop's color-separation tables and ink profiles.

The only serious criticism we have of Photoshop 5.0 is of its only marginally improved Web graphics tools. So although you can now preview an image when you convert 24-bit color to 8-bit, you still can't generate an image map for Internet URLs. But for image enhancement, creative photo compositing, and prepress prep, Photoshop remains the program the pros choose.

Adobe Photoshop 5.0. Street price: $650 (upgrade, $199). Requires: 32MB RAM, 80MB hard disk space, and Microsoft Windows 95 or NT 4.0 or later. Adobe Systems Inc., San Jose, CA; 800-492-3623, 408-536-6000; www.adobe.com. *403 at www.pcmag.com/infolink.*

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PERIPHERALS

Decoder on a Card

With Margi Systems' DVD-to-Go PC Card you can watch DVD movies on your notebook.

By Alfred Poor

Maybe you missed out on the Captain Midnight Secret Decoder Ring when you were a kid, but now you can get a high-tech gadget that will put science fiction right on your notebook. Now that DVD-ROM drives are small and light enough to take the place of CD-ROM drives in notebook computers, the new DVD-to-Go card ($350 street) from Margi Systems lets you watch DVD movies right on your laptop.

DVD drives make a lot of sense for notebooks: They can read CD-ROMs as well as DVD-ROM disks, which hold nearly seven times as much data. If you want to watch a movie, however, you need to add MPEG-2 conversion and AC3 digital audio support. The DVD-to-Go is a PC Card that can add this support to many laptops.

PLUG IN! *The DVD-to-Go fits any ZV Type II PC Card slot.*

The card requires a Zoomed Video (ZV) Type II PC Card slot. ZV is a new point-to-point bus, designed specifically for notebook applications, that lets the PC Card write directly to the graphics controller's display buffer. This bypasses the system bus and CPU, eliminating the need for bus mastering or arbitration. The result is windowed or full-screen video playback with a significantly lower strain on system resources.

Setting up and installing the Plug-and-Play, hot-swappable card is easy. The initial configuration process requires you to specify your DVD zone (The titles of DVD movies are restricted by regional codes for different parts of the world). DVD-to-Go also comes with a DVD navigation program that provides a VCR-like control panel on which you can choose standard DVD settings, including dialog language and subtitles.

You can view the DVD movie output on your laptop screen or use the pigtail connector to make external connections. There are separate composite and S-Video connectors, plus left- and right-channel stereo connections. You can choose to turn the external video signal on and off using the player software.

On our tests with a Digital HiNote VP765 with a 266-MHz Pentium II CPU and XGA active-matrix screen, the DVD-to-Go worked flawlessly. Images were crisp, and motion was smooth. Even using a composite video output to a television monitor produced excellent image quality. There were no obvious motion artifacts, posterization in scenes with fast action, or other signs of decoder problems. Sound quality was also excellent.

Airlines have started to experiment with seat-back movie screens, but a good-quality notebook with a DVD-to-Go card and a set of headphones may be a more satisfying way to provide your own in-flight entertainment. Even if your plans are more down to earth, this card makes quality portable DVD playback practical for home or office.

DVD-to-Go. Street price: $350. Margi Systems Inc., Fremont, CA; 888-656-2744, 510-657-4435; www.margi.com. *404 at www.pcmag.com/infolink.*

LS-120 DRIVES

Mobile Mass Storage

Take more information on the road with the Maxell SuperDisk PC Card LS-120 drive.

By Asa Somers

It may not be a universally recognized standard yet, but LS-120 technology is quietly staking its claim as heir to the floppy disk drive, thanks to its 120MB storage capacity and backward compatibility. As new notebooks hit the market with LS-120 drives built in or offered as options, users still toting last year's laptops can jump on the same storage bandwagon with the $280 (street) Maxell PC Card SuperDisk Drive.

The SuperDisk, like all LS-120 drives, uses a laser to position its read/write heads over very fine servo tracks etched into the surface of the disk platter. Since the laser is so precise, LS-120 disks feature 2,490 data tracks per inch, compared with 135 for floppy disks. In this way, LS-120 disks accommodate much more data in the same surface area.

At less than an inch thick and weighing only 10 ounces, the SuperDisk appeals to even the most road-weary mobile pro. It sets up with virtually unconscious ease, plugging into any Type II or III PC Card slot and requiring only a standard IDE hard disk driver (included in Windows 95).

We installed The SuperDisk on three notebooks with little effort, and in each case we were rewarded with a bouncing baby E: drive icon, letting us then drag and drop files. And because the SuperDisk is an external device, it's especially effective as a means of data transfer between two legacy notebooks.

The device draws its power through the PC Card interface, so in most cases there's nothing else to set up. But Maxell includes a small AC adapter in case you have an older laptop or a mini-notebook that is too low-power to handle the job itself.

Although we did experience impressive throughput with the SuperDisk, we never saw anything like the 290-KBps data rate LS-120 technology supposedly provides. We saw a maximum effective throughput of 170.7 KBps all the way down to 69.6 KBps, depending on file type and especially on the number of files transferred. For example, we copied the single 5.2MB Winword application file in 36.1 seconds, an effective throughput of 143.9 KBps. But a single 1.6MB transfer of 18 separate graphics files took 17.3 seconds, an effective throughput of 94.7 KBps.

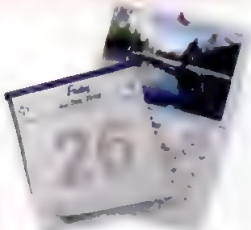
The SuperDisk itself isn't cheap. And while LS-120 diskettes blow floppies away in terms of dollars per megabyte, at around $13 each, they still have a long way to go before they're the next "disposable" storage medium.

Maxell PC Card SuperDisk Drive. Street price: $280. Requires: Microsoft Windows 3.1 or higher. Maxell Corp. of America, Fair Lawn, NJ; 800-533-2836, 201-794-5900; www.maxell.com. *405 at www.pcmag.com/infolink.*

PHOTOGRAPHY BY THOM O'CONNOR

25 Essential Tools for Home and Business

Simply FUNctional



#12

Photo Calendars Schedule everything with four customizable calendars. Use any images - even your own pictures - to create a calendar as individual as your schedule.

#21

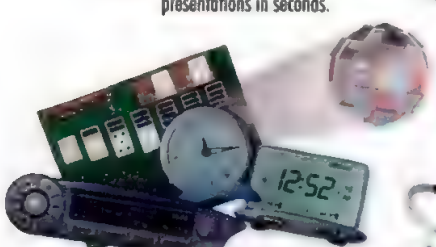
Safe and Secure The ultimate security for all your sensitive documents. Simply drag and drop files on to the safe icon to automatically encrypt them to prevent unauthorized access. To remove your sensitive files, simply drop them in the Gizmos Shredder and even the best file recovery software can not resurrect them.

#15

Picture Organizer View, store, and organize your images instantly. Drag and drop your images into any other Gizmos applications easily.

#9

Performer™98 Just drag and drop your pictures onto Performer98's time line to create stunning television-quality presentations in seconds.



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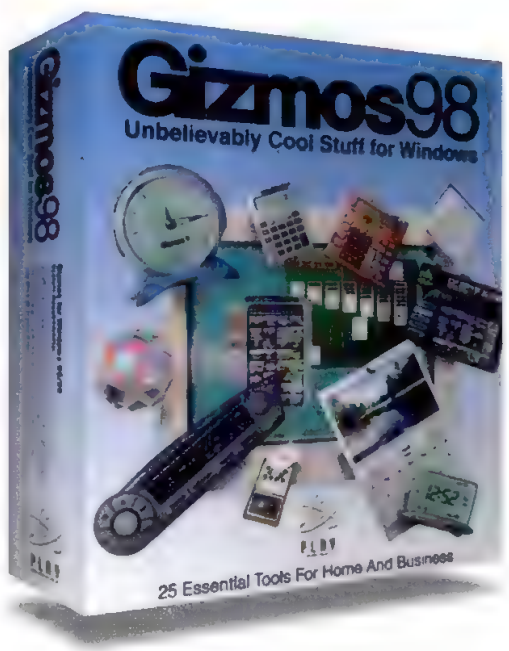

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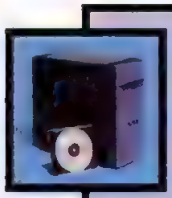
MMX intel inside pentium



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ANIMATION SOFTWARE

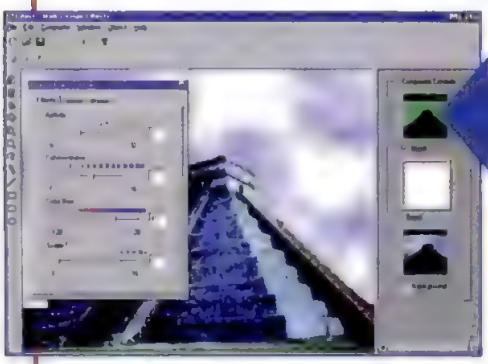
Web Animation Creation

New animation tools from Intel and Microsoft let you create dazzling graphics for your Web site.

By Jan Ozer and Luisa Simone

Web developers adding animation to their Web sites face two tough hurdles—creating the animations and integrating them in a productive, aesthetically pleasing way. With more than 2,000 editable clip-art elements (many matching FrontPage templates), Microsoft's $149 (list) Liquid Motion helps solve both problems. Throw in a Java-based plug-in with a free delivery system, and you've got a compelling tool for all Web developers.

With the release of Web Design Effects 1.1 ($149 list), Intel introduces a whole new approach to animation on the Internet. With something called *procedural animation,* a single bitmapped picture and a few lines of code are all you need to create nonrepeating patterns that simulate the motion of natural phenomena like fire, clouds, and water.



The changing clouds in this sample animation are generated from the simplest of seed images in Intel's Web Design effects.

LIQUID MOTION

With Liquid Motion, you design in a two-screen interface; the larger screen shows WYSIWYG design and the left screen shows the content and associated behaviors and activities. One timeline sits just beneath the menu screen for coordinating various elements.

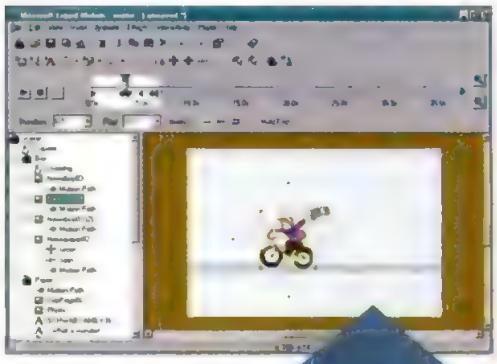
Liquid Motion includes canned 2-D and 3-D shapes that you can reshape and recolor at will; it warns you if you select a shape incompatible with certain browsers. You can also create text strings, though fonts are limited. Liquid Motion can also import JPEG and GIF images, WAV and MIDI files, and several audio formats (but not RealAudio). Then it's time to add animation.

Canned effects include random jumping, grow and shrink, and 2-D and 3-D spin. You adjust animation speed by increasing or decreasing the time of the effect. You can move objects freehand, record, and later edit the path.

There are several integrated effects such as color cycling, sparkles, and bubbles, as well as such interactive effects as "follow the mouse" and moving an object and hyperlink to remote Web sites. You can trigger all effects and animations to start when someone enters the scene or upon mouse click, mouse-over, mouse-off, and mouse release.

A wizard handles all publishing chores, selecting relevant options and compiling files for the intended publishing medium, which includes direct insertion into a FrontPage Web project. Since they're Java-based, most animations play back on Netscape, AOL, and IE Versions 3 and 4 browsers on Windows, Macintosh, and Unix platforms.

Though Liquid Motion does not require a plug-in, there is a one-time download of up to 223K of Java installers, executables, and classes. Otherwise, animations are quite condensed, often only 5K to 10K over the base content files.



Liquid Motion provides a number of editable templates, which can be easily customized by nontechnical users.

Although capable of truly complex animations, Liquid Motion is at its best modifying the third-party and included buttons, banners, and free-form content. In this mode, Liquid Motion can deliver engaging animated content, regardless of the Webmaster's experience.

Liquid Motion. List price: $149; for registered Microsoft Office and FrontPage users, $54.95. Requires: 16MB RAM, 30MB hard disk space, Microsoft Windows 95, 98, or NT 4.0 or later. Microsoft Corp., Redmond, WA; www.microsoft.com. *406 at www.pcmag.com/infolink.*

WEB DESIGN EFFECTS

Where traditional frame-based animations require long download times or wide bandwidth connections, Intel's new procedural animation transmits quickly, plays smoothly, and looks great—provided the viewer's system is properly equipped. Intel's reliance on sophisticated hardware may be a serious drawback, because it doesn't address viewers with slow processors, 256-color capability, or Mac systems—a significant portion of the Web audience.

The inner workings of a procedural animation consist of JavaScript and VBScript code. If you're an adept programmer, you can type commands directly into your HTML editor. The functions load one seed image and then apply a series of algorithms to change the color, position, and grouping of pixels in the picture over time. For example, the cohesiveness settings might determine whether you produce stratus or cumulus clouds, and the motion setting can change the direction of the wind. You can create more elaborate compositions by layering a mask and a static background image with the animation.

For nonprogrammers, the Web Design Effects authoring program uses menus and dialogs to load source images, adjust parameters, create masks, and preview the composite animation. At output time, the program writes code that can be cut and pasted into an HTML document.

Unfortunately, the authoring program is poorly documented, idiosyncratic, and hobbled by a rudimentary tool set. It can import BMP and JPEG files only, so to use Web formats such as GIF or PNG, you must edit the HTML code by hand.

Web Design Effects needs a number of improvements, including a standardized interface and more robust editing tools. We applaud the underlying technology, however, and believe that procedural graphics have an important role to play in Web-based animation.

Intel Web Design Effects 1.0. List price: $149. Requires: 16MB RAM, 10MB hard disk space, Microsoft Windows 95 or NT 4.0 or later. Digital Imaging and Video Division of Intel Corp., Chandler, AZ; 800-538-3373; www.intel.com. *407 at www.pcmag.com/infolink.*

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UTILITIES

Ready, Set, Go!

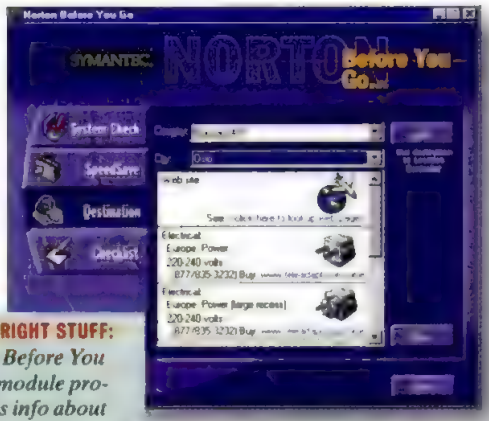
Norton Mobile Essentials gets your laptop ready for the road and makes sure it works once you're there.

By Asa Somers

If you're a road warrior going on yet another business trip, chances are the process of backing up files, checking your hard disk and modem, and resetting your laptop's location-specific info has become—well, a pain in your carrying case. Symantec feels your pain and has responded with its $80 (street) Norton Mobile Essentials (NME).

The main window offers a few small utilities and three main options. Clicking on the first, Before You Go, brings up a screen filled with trip-preparation tasks. System Check lets you test your modem, scan for viruses (via a version of Norton AntiVirus), and check your hard disk for sector flaws. You can even set it up to run other third-party utilities.

The Destination option calls up information about international ports of call, including useful Web links. Rounding out Before You Go is the useful SpeedSave module, which backs up selected files from your hard disk and saves them as a ZIP file on floppy disk or creates an archive of networked files that you can take with you. In testing, it worked well, backing up and restoring the files we chose and spreading the archive file over multiple floppy disks when necessary. You can even set up multiple backup profiles for specific travel circumstances.



THE RIGHT STUFF: *The Before You Go module provides info about your destination, including the electrical and phone adapters you'll need when you arrive.*

Another major part of NME is the Location Manager, which saves you time by adjusting system settings whenever you head off to some far-flung corner of the globe. With a single click, NME changes your clock, printer and network settings, dialing protocol, and Internet connection and even the programs that launch at start-up.

Finally, the Connection Doctor module troubleshoots Internet access problems. It tests for installed equipment, IRQ conflicts, swap-file space, and phone-line quality and will access a Symantec remote server (or any server you specify) to make sure a reliable data connection can be attained.

NME is a convenient little toolbox for those constantly on the road. But most of its capabilities lie within Windows 95 itself, even if they're a little hard to find.

Norton Mobile Essentials. Street price: $80. Requires: 8MB RAM, 10MB hard disk space, Windows 95 or 98. Symantec Corp., Cupertino, CA; 800-441-7234, 541-334-6054; www.symantec.com. *Choose 410 at www.pcmag.com/infolink.*

DYE-SUBLIMATION PRINTERS

Low Cost, Photo Quality

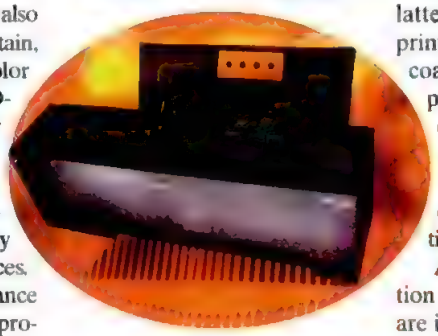
The Alps MD-1300 dye-sublimation printer gives you photo-quality prints at a bargain price.

By Daniel Grotta and Sally Wiener Grotta

Letter-size dye-sublimation printers capable of producing professional-quality continuous-tone color output usually cost at least $7,000. They're also often difficult to set up, maintain, and optimize for accurate color fidelity. But the Alps MD-1300 dye-sublimation printer ($500 street, with rebate) can generate excellent photo-quality prints, indistinguishable from those produced by far more expensive devices. Note that its slow performance makes it inappropriate for professional production.

A file with an 8- by 10-inch image takes from 16 to 20 minutes to print. Our 17.1MB TIFF test file took 17 minutes, 41 seconds to produce output. To improve performance while reducing per-print cost, the MD-1300 can print to precut 4- by 6-inch paper.

Setup involves popping in



three or four ribbon cassettes, installing the printer driver, and inserting up to 100 sheets of paper or card stock in the sheet feeder. You must then choose the correct document type and select manual or automatic paper feed. You also must ensure that the correct corresponding ribbons and paper are installed.

The MD-1300 can produce continuous-tone 600- by 600-dpi photographic output or 1,200-by-600 photo-realistic output. If that's confusing, it's because Alps's documentation doesn't clearly distinguish photographic from photo-realistic mode. The latter is a dithered pattern that prints on photocopy or generic coated paper and uses Alps's proprietary Micro Dry ink cassettes. The photographic mode is true continuous-tone printing that uses special paper and dye-sublimation ribbon cassettes.

Although the dye-sublimation and Micro Dry ribbons are in different-color cassettes, they're unlabeled and easy to confuse. The driver's paper-selection menu offers many choices; if the paper and ribbons are mismatched, either the printer won't print or the ribbons will melt.

Alps has done an excellent job of improving its ribbons and print-head technology. The half-inch swathe the ribbons make on each pass no longer creates visible bands. Colors are rich, saturated, and accurate, and the images are sharp and detailed. The unit can also produce less-expensive, near-photo-quality color prints to photocopy or generic paper; monochrome text; and special-effect metallic colors.

The MD-1300 is a clear choice for those looking for versatility and high-quality output. But they'll have to know how to match the media and learn to endure the MD-1300's ultra-slow performance times.

Alps MD-1300. Street price: $500 (after $50 mail-in rebate, available until November 1998). Requires: 16MB RAM, 20MB hard disk space, Microsoft Windows 3.1 or later. Alps Electric Inc., San Jose, CA; 800-825-2577, 408-432-6000; www.alpsusa.com. *Choose 411 at www.pcmag.com/infolink.*

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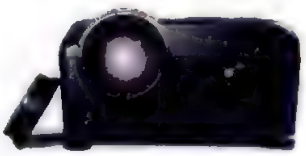

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Second Looks

MICROSOFT OUTLOOK 98

Better All Around

By John Morris

When we began testing for our recent e-mail and messaging roundup ("Take Control of Your E-Mail," May 5), we weren't expecting much from Microsoft Outlook 98. After all, the first version of this hybrid e-mail client and personal information manager (PIM), Outlook 97, generated a less than enthusiastic response. But the late beta of Outlook 98 that we tested was a pleasant surprise, as Microsoft had improved performance, added support for a raft of Internet standards, and enhanced the interface and features.

MOVING MOUNTAINS

Outlook 98 is at its best when handling mountains of mail. To move a message to a folder, you simply right-click on the message and select the appropriate command. And you can sort mail quickly in any folder by clicking on headers for the sender, date, subject, or any other field.

But the true power of Outlook 98's message management is most evident in the new Organize toolbar, where you can sort mail into folders, configure Outlook 98 to assign colors to incoming messages based on their content, and create and apply rules and filters. From this toolbar, you can also launch a rules wizard that lets you build even complex rules very quickly. You can build rules based on a host of criteria (sender, text in subject line or message body, and so forth) and trigger a range of actions, from sorting into folders to flagging for follow-up or deletion.

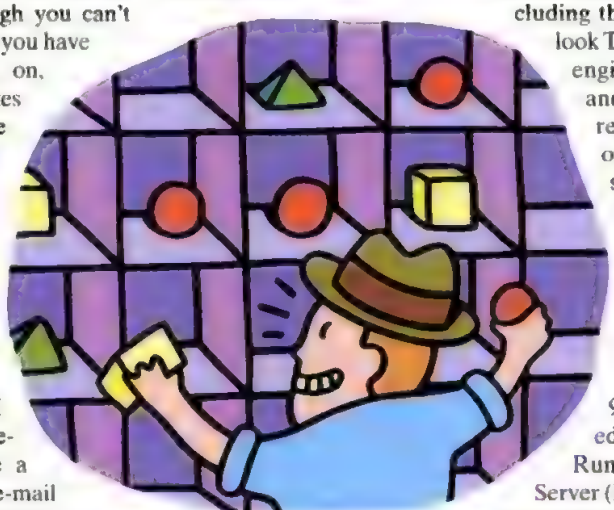
LOSE THE SPAM

The new built-in spam filter has proven to be one of the more controversial features. Some users feel the filter is overzealous and others complain that it fails to catch all spam. Outlook 98's development team did research to select the list of telltale words and punctuation; to see the list, search your C: drive for the file Filters.txt. Although you can't edit this list, when you have the filter turned on, Outlook 98 creates a rule (called the Exceptions List) for adding e-mail addresses and domains from which you want to receive e-mail.

The integration of this powerful e-mail client with PIM features reaps rewards. To create a task based on an e-mail message, for instance, we dragged the message onto the Task icon in Outlook 98's vertical toolbar. The same approach works for creating a calendar entry or contact record based on a message: Outlook 98 automatically parses the sender's name and inserts the e-mail address in the appropriate field. If you have more than one contact from the same company, just select New Contact from Same Company under the Actions menu. These data-entry shortcuts can save loads of time.

MINOR GLITCHES

The late beta of Outlook that we reviewed wasn't without its quirks. The program automatically imports data from a multitude of other PIMs but not from Symantec's ACT! 4.0. To do that, you must export the data as a CSV file and map the fields manually. Beta versions of Outlook 98 included a field-mapping utility licensed from DataViz to help customize the process. Microsoft has left this utility out of the final version but says it is working with DataViz and plans to offer a downloadable replacement. In the meantime, an article in Microsoft's online Knowledge Base provides workarounds.



Outlook is at its best when you need to handle lots of mail.

Users have reported a few other glitches in the final version of Outlook 98. For example, when you attempt to send a secure message, under some circumstances the message can travel without the digital signature, the encryption, or both. Although Microsoft has not been able to reproduce the problem, the company does have a Knowledge Base article that details the problem and its solution (that is, you should request additional security to protect your private key when you are applying for a VeriSign digital ID).

THE INTEGRATED BROWSER

Outlook 98 is perhaps the best argument yet that the browser should be part of the operating system. Microsoft refers to Internet Explorer 4.01 as Outlook 98's "core OS component." (If you don't have IE4 installed, a program called Setup will install portions for you.)

Although this approach is bound to produce protests, it is based on some sound reasoning: Outlook 98 borrows IE4's HTML-rendering engine (the interface is based on HTML, including the innovative Outlook Today screen), script engines for VBScript and JavaScript, news reader, and security options. You can also schedule NetMeeting within Outlook 98, send e-mail, create contact records, and access your calendar from IE4.

Unlike Outlook 97—which supported an option called Run from Network Server (RNS)—Outlook 98 also requires a local copy of Office 97, a problem that Microsoft says it will fix in the next version. Outlook 98 also has an integrated version of Symantec WinFax Starter Edition for Internet faxing.

Our only complaint is that Outlook 98's interface tends to become cluttered. In some cases, we had the vertical toolbar, in-box, message preview pane, Organize dialog box, and Office Assistant all open at once. But we found the program relatively easy to use, and when you consider all that it does, a little screen clutter seems a fair trade-off.

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Business 3-D and Other Myths

Within this column, I often talk about all the other things you can do with a PC beyond business use. But here I'm taking a PC that's an unabashed gaming monster and looking for business applications, and I'm not having a lot of luck. I've heard breathless commentators talking about "the mass market for 3-D applications" for years, and I have yet to see it. And my crystal ball isn't seeing it either, unless it's the market for games.

I'm running a new AMD K6/2 processor with those whizzy 3DNow extensions. At 333 MHz and with a 95-MHz system bus, this baby is noticeably faster than my 233-MHz machine. It has a couple of game demos—previews of yet-to-be-released games tweaked to use the 3DNow extensions—that just have to be seen to be believed.

In Rage's Incoming, shock waves from the missiles you launch are visible in the air. Flashes illuminate nearby objects, and you can see yourself in reflective surfaces. As you approach landscape formations, they get more detailed instead of breaking down into big, blocky pixels. Animation is smooth and fast, much like that of dedicated arcade games or a Nintendo 64. All the other cool 3-D stuff—fog, shading, and so on—is there in full force.

The other game, Microsoft Baseball, has camera pans, zooms, and perspective changes—much like what you'd see watching a baseball game on your TV. The graphics and animation are superb.

Much of this is attributable to nVidia's excellent Riva 128 3-D graphics card, some to processor speed and 64MB of RAM, and some to the 3DNow instructions—a set of floating-point extensions specifically intended for 3-D effects such as lighting, shading, and texturing. The combination is definitely greater than the sum of the parts. AMD, Cyrix/National Semiconductor, and IDT worked together on the project, and the goal was to out-MMX Intel's MMX instructions. I'd say they succeeded.

So the AMD K6/2 makes for one heck of a game machine. Now let's look at its performance at the office: It's fast, as you'd expect from any K6 machine loaded to the gills with high-performance components, but on-screen images don't look any better than in a Pentium-powered system. Why? Because business applications don't use 3-D.

Then, too, you have to define what you mean by *3-D*. Is it those 3-D bar charts you do in Excel? No, they look the same whether you've got a "business" video card or a game-oriented card. Is it DVD decoding? Nope. Although DVD decode is increasingly included in video chips that also do 3-D, it's a separate function. Is it a realistically shaded animation on your screen in 3-D? Maybe, if the animation moves in all planes, but the images are probably just a series of bitmaps that the software sequences through to simulate animation. Is it 3-D CAD and solid-modeling programs? Not really, because their goal is to produce a single instance of an object, although that object's underlying geometry, surface textures, and colors may be included in an animation program.

OVERKILL

With my K6 gaming monster loaded to the gills, my spreadsheets look like... spreadsheets.

Real 3-D is geometry engines, texturing, and shading, but combined with motion. It's frame rates and refresh rates, and holding artifacts to an imperceptible minimum. It's multiple objects in motion—reflecting, casting shadows, and responding to multiple light sources.

Microsoft has promised to support 3DNow in its forthcoming DirectX 6.0 drivers, and a prerelease version of Microsoft Baseball looks as good as any arcade game. Of course, Microsoft will give Intel's Katmai processors their own 3-D–optimized extensions, but the chips won't be available until some time in 1999.

I find myself wondering what sort of clock cycle–burning enhancements the software wizards will have waiting for us once these 3-D extensions become commonplace. Even more useless effects in PowerPoint slides? Will we be able to control multiple lighting sources in our presentation slides?

One 3-D application area that holds some promise is Web advertising. A little motion goes a long way toward increasing the clickability of an ad banner, but users balk at the increased download times that come with complex animated GIFs and fancy typography.

3-D browsers can display pages that are more visually interesting yet load faster than their non-3-D equivalents. Check out *www.cosmosoftware.com* for a VRML plug-in that you can add to your browser and some examples of 3-D applications. I'm encouraged to see VRML applications move beyond those dopey 3-D chat worlds. PC

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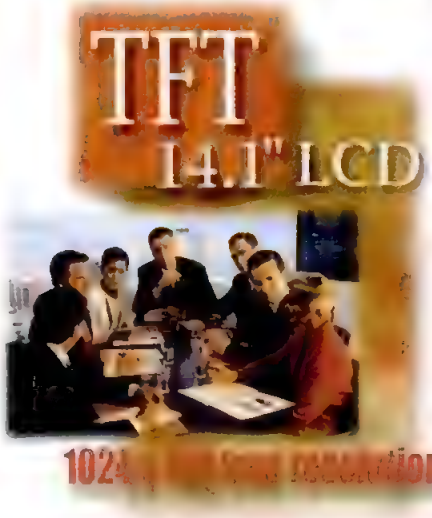

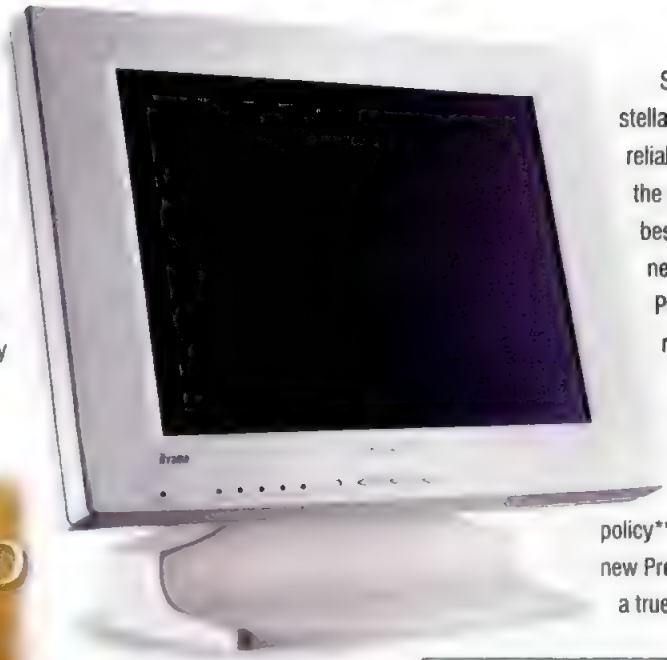

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JOHN C. DVORAK

Batteries Not Included

Why aren't standard-cell rechargeable nickel hydride batteries available in the United States? They've been sold in Japan for over two years. When you discover the benefits of these batteries, you immediately see the end of the Energizer bunny, finally.

Anyone who uses a high-resolution digital camera knows that standard disposable batteries can cost almost as much as film and developing for a regular camera. Taking about 40 megapixel shots on any CCD digital camera would chew up a complete set of alkaline batteries. Some time back I discovered that rechargeable nickel cadmiums last longer, because they can deliver quick amps with more efficiency than alkalines. Then Olympus quietly started shipping nickel hydride batteries with its cameras, and they lasted twice as long as anything I'd ever used and were rechargeable, too.

Ken Hawk, the president of 1-800-Batteries, is a big fan of these new nickel hydride AA batteries. Using a low-resolution camera, he did a quick study of their usefulness, and the results were astonishing (see the table below). Only nonrechargeable lithium batteries can outperform them. He also tested a standard nickel cadmium and a plain carbon battery, both of which gave fairly poor results. My experience with nickel cadmium batteries was better—not worse—than with alkalines. Hawk had the camera flash on for all his pictures, which probably changes some parameters. He also took pictures at 10-second intervals, which affects the way the batteries respond.

Environmental concerns over cadmium could eventually eliminate nickel cadmium batteries anyway. And since the nickel hydride battery is so far ahead of the rest of the pack, who cares? The nickel hydride battery has an energy density two to three times that of nickel cadmium and no memory effect. The battery works to minus 20 degrees Celsius, and the documents I've seen indicate that nickel hydride battery technology isn't even fully optimized yet.

The calculation of cost for nickel hydride batteries in the table is for 100 recharges. Hawk says the industry knows that nickel hydride batteries can easily last through 500 recharges. I've seen data indicating that 1,000 charges are possible. This drops the cost per 10,000 pictures to 70 cents! I'm convinced that the industry doesn't want people to know about these batteries. I seriously doubt you'll be seeing them on a rack in the grocery store anytime soon. Do the math: It's like buying 1,000 alkaline batteries for less than 10 bucks. Imagine what this does to the lucrative disposable-battery business.

FLIMFLAM

I'm convinced the industry doesn't want people to know about these batteries.

Even when nickel hydride batteries are sold with cell phones and laptops, we are subtly led to believe that the increased battery life has more to do with the technology of the product than with the battery itself. The promotion of this revolutionary battery technology has been quite low-key. Here's another kicker: You can fully recharge nickel hydride batteries in less than 2 hours.

So now I wonder where the D, C, and AAA nickel hydride batteries are? Mostly in Japan. As far back as January 1996, Toshiba rolled out the first complete line of standard cells and other Japanese battery makers have followed. This event was essentially hushed up in the U.S. market. The big-name American battery companies have avoided this market-killing technology for obvious reasons. The only manufacturer of standards cells in the United States is Harding Energy in Michigan. Duracell makes a nickel hydride battery pack sold for industrial applications but doesn't make standard cells. Try *www.greenbattery.com* for Japanese cells and special nickel hydride chargers. 1-800-Batteries has the AA camera batteries. These batteries are susceptible to damage from overcharging and require a special charger (one that will do a complete charge in about 2 hours is only $35).

It's time we woke up to the new reality of battery technology and got off the disposable treadmill, which is filling garbage dumps. You digital camera users need rechargeable nickel hydride batteries right now.

Battery	Price for four AA batteries	Number of photos per set	Cost per 10,000 photos
Duracell Ultra alkaline	$5	199	$251
Energizer lithium	$15	502	$299
Rechargeable nickel hydride	$25	368 per charge	<$7

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JOHN C. DVORAK

Inside Track

The big news in the chip arena is the **delay** of Intel's Merced processor. Intel didn't give specific reasons, but sources in the engineering community suspect a typical excess of optimism. The more cynical types suspect the scrutiny of Intel's alleged **antitrust and anticompetitive behavior.** The government is taking a close look at the use of vaporware as a marketing tool.

Since the day Intel rolled out the Merced specifications, it seems as if **every vendor in the world** lined up behind this chip, claiming that it will be an essential building block in every computer design from mainframe to workstation. I haven't seen anything like this since the **megahype** surrounding the initial release of Windows NT. As you may recall, NT was going to take the world by storm some years back. Much of the ado was caused by pre-announcement leaks and **bogus promises.**

I may as well be the first to say it: Just because you can network everything doesn't mean you have to. This sounds like something that will only complicate our lives.

A new, **kinder, gentler Intel** may be the result of coincidental developments. First, the case against Microsoft must scare Intel. Second, the departure of Andy Grove and his siege-mentality approach to management. Third, the sudden **stagnation** of desktop computing—insofar as the need for more powerful CPUs is concerned. Fourth, the appearance of new computing devices using non-Intel chips: handheld computers, set-top boxes, CE machines, and so on.

The entire Merced strategy may have to change as the new scene unfolds. This is all somewhat ironic, because the same week Intel pushed back the release of Merced, the company announced that its other processors were suddenly coming onstream **faster than anticipated.** This includes the 400- to 500-MHz Katmai, now expected in Q1 of 1999, and an **improved Celeron (already?) this year.** Celeron will include a 300-MHz part with an integrated 128K L2 cache. This will be Intel's answer to the cheap chips from competitors and will appear at Comdex.

Motorola, meanwhile, is working on **two code-named** projects—Blackbird and Project X—for so-called consumer platforms. These include set-top-box–type devices and hand-held computers. I think the original name for the now-defunct computer magazine *Corporate Computing* was also Project X. A **jinxed name** if ever there was one. I believe the Motorola project is part of an **elaborate home-networking scheme** based around the set-top box and home entertainment. I may as well be the first to say it: Just because you can network everything doesn't mean you have to. This sounds like something that will only complicate our lives. **The real impetus** is that marketing types will have a new way to spy on us. Who needs it?

Cocktail Party Buzzwords Dept.: As we endure another iteration of overpromoted consumer-electronics devices led by ever-cheaper DVD, you'll see more and more attention being paid to the **media processors** being developed by everyone with access to a foundry. The performance measurement for these devices is dubbed **BOPS (billions of processes per second).** The Matsushita MCP2, for example, can generate 8.3 BOPS at 135 MHz. Thought you should know.

Overlooked in this neo-mad dash to the TV is the most interesting development in desktop computing: the emergence of inexpensive hard disks with **enormous** capacities. By this time next year, many of you will have over 20GB on your machines, with maybe 4GB actually used up. This development and the sudden **doubling of capacity every 12 months** instead of 18 has created a new psychology for the computer user and the environment as a whole. In the past, users have had to clean up and maintain hard disks, as capacity was always being challenged by unnecessary files and dubious downloads. But today, even a graphics junkie can't put a dent in these disks. No housekeeping is ever done, and the disks contain lots of garbage. This makes it hard to find anything. In the past, we've cleaned out the disks only to recover space, not for ease of use.

The next wave in software will be searching and organizational tools to help us find lost documents and missing software on the massive disks. Visioneer has a new product called Visual Explorer, which looks like a step in the right direction. But even **more interesting** is **SuperSleuth,** which evolved out of WebSleuth. SuperSleuth is the brainchild of Seymour Rubenstein who, among other things, is the father of modern word processing (WordStar) and even desktop-software licensing.

I use SuperSleuth when doing serious research on the Web. The product can take 8 hours to run, but the results are phenomenal. SuperSleuth does more than search: It analyzes, validates, and indexes all the words used on all the pages found and **writes short abstracts, too.** Though not a difficult product to use, SuperSleuth is not trivial either, and **some hands-on instructions are needed.** Rubenstein feels that this was unavoidable, but it doesn't help sales in the current market for "dumbed-down" products. But more interesting is that SuperSleuth can take a **hard disk and treat it like a Web search.** AltaVista tried this, and its product pales in comparison. Within a few minutes, SuperSleuth breaks down the disk, based on your search criteria. **You can data-mine your own hard disk, system, or network.** Get a copy and learn how to use it. Killer. Absolutely phenomenal. It's $39.95 plus $7.95 shipping. Call Prompt Software at 408-370-5046. Or visit their Web site, *www.promptsoftware.com,* for a downloadable version. PC

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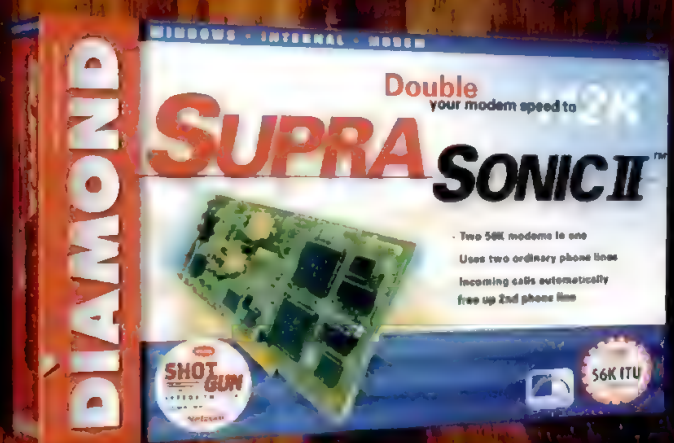

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JIM SEYMOUR

Using That Web Research

Sure, the Web's great. Wonderful. Very useful. You can find nearly anything you need. A great research tool, as well as a resource for education, entertainment, and all the rest. Invaluable to anyone trying to dig into something—whether writing a report, a thesis, or a business proposal or preparing a presentation.

But—umm—what exactly do you do with what you find on the Web? I mean, how do you store it, retrieve it, use it?

It's self-evident that the Web is a great resource. What's not at all self-evident is how best to capture, save, paw through, sort, and actually use what you find there.

WEB RETRIEVAL

How best to capture, save, paw through, sort, and actually use what you find on the Web?

We read lots about search strategies—how to find what you're looking for on the Web. But a lot less attention is paid to the other end of the process: using what you find.

You can, of course, easily grab Web pages from within your browser. Microsoft Internet Explorer, Netscape Navigator, and Opera all make it easy to grab Web pages intact and save them as either plain TXT files or in all their HTML glory as HTM files. You can also do old-fashioned "screen scraping" by selecting the text you want, hitting CTRL-C (or choosing Edit | Copy), then flipping to a word processor and dropping the text there with CTRL-V (or Edit | Paste). You lose all the graphics, of course, when you save with these methods, and sometimes that really hurts.

I can make an argument that if you're dealing with sites that have all important content in text only, you're dealing with the wrong sites. The Web has become an innately graphical medium, and increasingly, much of the value in Web-published material is in the charts, graphs, and other graphical devices included on pages.

That said, I've saved an awful lot of blocks of plain text from Web pages, sometimes building up Word files 100 pages or more in length from the clips. I then search those files using Word's Edit | Find command or use any of several good text-indexing programs for Windows to create and save a full index of the material.

That works but is not a very tidy or elegant process. It's also slow, and again, it forsakes all the graphics. When I'm very patient or when a particular graphic is extremely important, I right-click on the graphic within my browser and choose Save Picture As... for a full-bore file save, or I just copy it for a quick fix and then select Insert | Picture or just Edit | Paste to drop the graphic into my growing text file.

All this works well enough, if clumsily, when you're dealing with relatively modest amounts of information. But it stinks when you're assembling a large, deep research file.

We've seen several new products come to market lately that promise to make capturing Web pages faster and easier, with more useful results. Two have particularly impressed me and have earned space on the hard disk in my PC.

On the simplest level, for those times when you just want to grab a page—with its graphics intact—and e-mail it to someone (or to yourself, for a reference copy), the best bet is Insight Development's Hot Off the Web (*www.hotofftheweb.com*).

This is a handy utility for grabbing pages whole, including their graphics. What makes HOTW especially nice for sending a page to someone else is that after the product's grabbed the page, it will pack all the files up into one tidy, executable ZIP file. With one click, it will even send the package via your e-mail program. You can annotate pages you've grabbed with your own comments, highlight text, and even add corny little figures that have a decided Twenties style, using attention-getting words and phrases such as "Look at this!" and "Act now!"

Unfortunately, HOTW's operation is hardly self-evident, and it loads verrrry slowly. I suspect the next release will solve most of the interface and speed problems, but the current version is very useful. You can download a demo copy from the URL or download a full working copy for $49.95; or you can get a CD sent to you for $49.95 plus $6.50 shipping. Money well spent.

If you're gathering a lot of material and expect to have to search through it again and again, you don't want HOTW any more than you want to screen-scrape text into a Word file. Instead, go immediately to *www.asksam.com* and download a working demo of SurfSaver. Developer askSam Systems' slogan for SurfSaver is perfect: "The searchable filing cabinet for Web pages."

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SurfSaver grabs Web pages intact—again, including graphics—then saves them, with their HTML coding, in the askSam proprietary format. Links remain live in the captured pages.

A short digression: askSam has become something of a cult in the PC world, and I confess that I'm a member of the cult. The name's a play on a database technology—Sequential Access Method. So you "ask" SAM for what you need to know from your database, and askSam delivers it. The company has grown from a tiny Texas company, a decade ago, to a small Florida shop; there's better blue-water sailing in Florida waters, and Mack, Mike, and Bea McKinney, the people behind askSam, are nothing if not dedicated sailors. Now the company has a small product line built around the askSam technology. (You can find out more about their other products at the Web site.)

The key to understanding the value of askSam's approach is that it lets you store fully searchable data without creating a database structure. The big problem in creating databases is in knowing what you'll want to retrieve from the database, and how you'll want to find it—and knowing that before the database is created, so you can establish fields for every category of information. But askSam is based on "fieldless" storage and retrieval, from the user's standpoint. That approach turns out to be perfect for storing, searching, and retrieving data from Web pages, where structure is often a joke.

Once you've grabbed your pages and built your datafile, SurfSaver makes it easy to search through that messy accumulation and find whatever you need.

Like all askSam products, SurfSaver is more than a little idiosyncratic and quirky. It doesn't look or work much like other programs, and it's the better for it. You can download a full working copy of SurfSaver from the askSam Web site for $29.95, or call 800-800-1997 to order a CD for $39.95.

One issue: For now, SurfSaver supports only Internet Explorer 4.0, not earlier versions of IE nor any versions of Navigator. Those are coming, but today, SurfSaver's strictly an IE 4.0 product.

I love doing research on the Web. I love the serendipitous twists and turns of the Web. But I haven't loved the frustrations of saving, searching, and using what I find. SurfSaver has made my life easier and saved me many hours of time. That's a pretty good return on a 30-buck investment. PC

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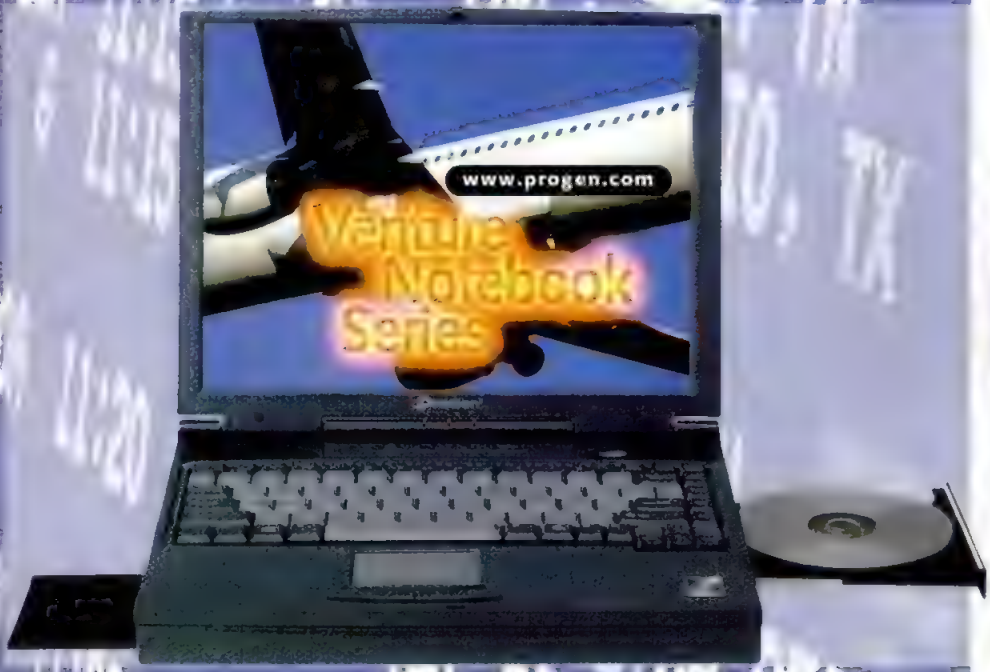

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Hardware Perspectives

Twenty bucks is a lot to pay for a modem cord, isn't it? Maybe not, if a cheaper cord fails on the road and you don't have a spare. Here's a rundown of some hardware products I've used recently that I really like—and believe you will too. These accessories start at around $10 and can cost as much as $2,000.

Best-ever modem cord. I've finally found one that holds up under a lot of abuse. When you're on the road, an unbreakable cable is more important than a cheap cable. The grandly named DataSpeed 100 Internet Cable (read: phone cable turned over to an ad copywriter) comes from Monster Cable, maker of well-regarded but not inexpensive audio/video and PC cables. It has snag guards, which protect the jack levers from catching, and a wonderfully supple, rubberlike jacket that makes it feel worlds better than a $3 phone cord. The cords range from 5 feet ($10 street) and 10 feet ($20 street) through 50 feet ($45 street). And the color choices (yellow, off-white, red, blue, and black) let you pick one that's hard to leave behind in your hotel room. (415-840-2000, *www.monstercable.com.*)

BEYOND GADGETS

The HP OfficeJet Pro 1175CSe is a fast color ink jet printer that's also a copier and scanner.

Swiss Army knife printer. Hewlett-Packard comes closer still to perfection with its second-generation OfficeJet Pro 1175CSe multifunction color printer, auto-feed copier, scanner, and sort-of-fax machine. In this all-in-one device ($1,000 street), you get a fast 600-dpi ink jet printer that also makes very good color copies and 300-dpi color scans. With the automatic document feeder, you can stick in 30 originals for unattended copying or 30 to-be-scanned documents. There's a scan-to-fax button, which scans originals into your PC via the two-way printer port and then fires up the included Symantec WinFax 8.0. This feature works well, but using it is not as convenient as having a real fax machine built into the 1175CSe. Maybe the third generation will be the charm. (800-552-8500, *www.hp.com/go/officejet-pro.*)

Space-conscious audio CD–player software. Most CD-player software takes over much of your screen, because the players are made to look like on-screen boom boxes. Call it "visual bloatware." Check out CD Valet 3.31 (formerly called EasyCD2, but not related to Adaptec's EasyCD Creator), a $10 shareware download from *www.ghlsoftware.com.* (Though it's not quite hardware, it's a hardware enabler.) In just 180 by 36 pixels of screen space, you get a full-function audio CD player that automatically looks up CD titles and track information from online CD databases (see *www.cddb.com*). CD Valet is proof that less is more.

Wireless Internet connection. What would it be worth if you and your notebook PC could stay connected to the Internet around your house and backyard or around the office? Check out the IBM Cordless Computer Connection, $179 direct. If you imagine a 900-MHz Matsushita cordless phone on which the keypad has been replaced by an RJ-11 jack, you'll have a pretty good idea of what the 2-pound CCC looks like and does. The device clips to the back of your LCD; the rechargeable battery is good for 2-plus hours of use. (800-772-2227, *www.ibm.com/pc/us/accessories.*)

Road-warrior speakers. Now that my notebook has a built-in CD-ROM drive and I carry half a dozen audio CDs for entertainment on the road, I've been searching for compact speakers I can use instead of the small, built-in speakers. I'm currently enamored of the 2-pound satellites of the Mediaphile Presentation Audio System ($249.95), although I leave the included 5-pound subwoofer unit at home. Great sound, great-looking speakers—at a price. (612-559-1019, *www.mediaphile.com.*) Cheaper, quite good, and heavier (because you can't leave the subwoofer home) is Cambridge PC Works, $156.96 direct and 14 pounds for the speakers, an optional battery, and a shoulder case (you pay $69.99 for the speakers alone). (800-367-4434, *www.hifi.com.*)

Film dust-and-scratch removal. This one is niche-y, and I have limited hands-on experience, but I'm convinced products like this will usher in the digital darkroom. Digital Ice, from Applied Science Fiction, electronically removes—no ifs, ands, or buts—dust and scratches from film when it's being scanned. Currently available only on the new Nikon CoolScan LS2000 film scanner ($1,899 list), Digital Ice makes an infrared scan of the film's base and emulsion layers. Anything it finds on the layer that isn't flat, smooth, or clear it maps as a defect and "subtracts" from the final scan. Look for it to work its way down the price ladder. Nikon was smart to get on board first. (512-651-6200, *www.asf.com*; 800-526-4566, *www.nikonusa.com.*) PC

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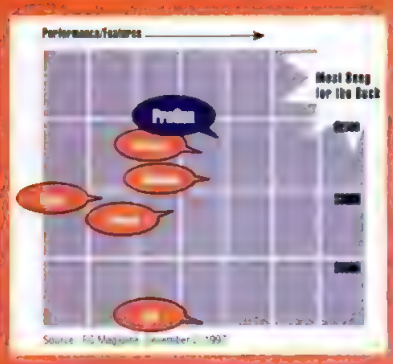

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Windows 98 put to the test

BY MICHAEL J. MILLER

The wait for Windows 98 is over. How good is the final product? Should you upgrade? PC Magazine Labs puts Windows 98 through its paces and uncovers some good news—and some worries.

We've been hearing about Windows 98 for a long time, ever since it was supposed to be Windows 97. But it's only now—once we have the final shipping software—that we can really judge Microsoft's claims about the quality of the operating system.

At PC Magazine Labs, we tested the final upgrade version of the system on dozens of machines and found that, as usual, Microsoft has delivered on the bulk of the features promised for the new OS. This includes the controversial extensive integration of Internet Explorer; the conversion of hard disks to the FAT32 file format, which allows for larger disk partitions with more efficient data storage; and improved support for new hardware, specifically for devices using the Universal Serial Bus (USB).

Although we liked all these new features, we did encounter a few problems as we upgraded specific systems. We also found the improvements in performance to be minor and limited to certain areas. (Microsoft hasn't claimed that general performance would

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ILLUSTRATIONS BY CLEMENTE BOTELHO

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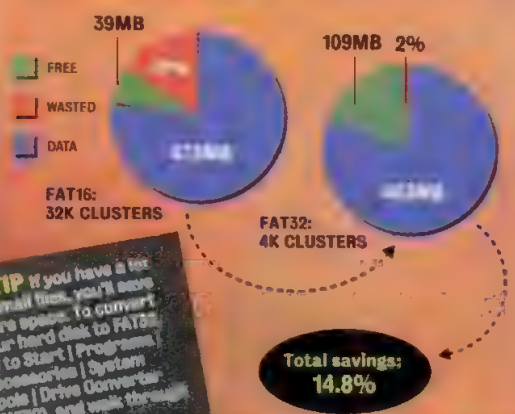
Hard Disk Space Savings

Microsoft says . . .

. . . that on the average, you should have 28 percent more hard disk space when you convert to FAT32 in Windows 98.

PC Magazine Test Results

We found significant space savings, although not as much as Microsoft claimed. We tested with 3,974 large and small files (396MB of data) on a 512MB hard disk.



▶ TIP If you have a lot of small files, you'll save more space if you convert your hard disk to FAT32. Go to Start | Programs | Accessories | System Tools | Drive Converter (FAT32), and work through the wizard.

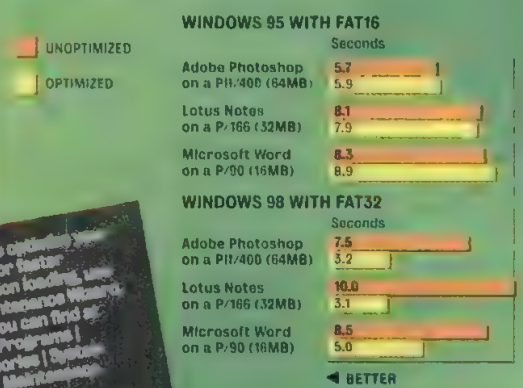
Application Load Time

Microsoft says . . .

. . . that launching applications under Windows 98 is "substantially faster" than opening the same programs under Windows 95.

PC Magazine Test Results

We did see a dramatic difference loading applications under Windows 98, after converting to FAT32 and optimizing our hard disk. Here are some highlights.



▶ TIP To optimize your system for faster application loading, use the Maintenance Wizard, which you can find at Start | Programs | Accessories | System Tools | Maintenance Wizard.

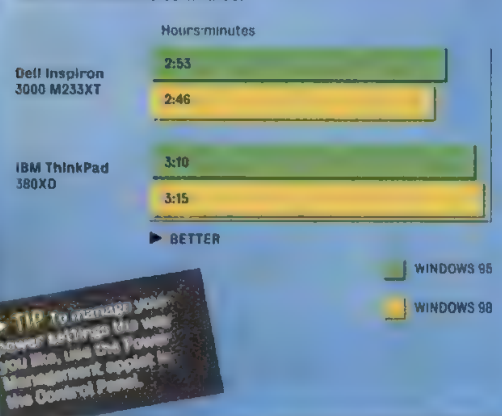
Battery Life

Microsoft says . . .

. . . that battery life will be no shorter under Windows 98 than under Windows 95 if you're running a non-ACPI machine. It expects significant improvements if you have an ACPI-compliant system with fast boot BIOS enabled.

PC Magazine Test Results

Microsoft is right about battery life on non-ACPI systems. Using ZD BatteryMark 2.0, we found almost no difference between Windows 95 and 98.



▶ TIP To manage your power settings the way you like, use the Power Management applet in the Control Panel.

Upgrading to Windows 98

Microsoft says . . .

. . . Windows 98 will be the easiest upgrade ever.

PC Magazine Test Results

For the most part, it is. We upgraded dozens of machines—old and new, clean and dirty, desktops and laptops. Here are some problems that might affect you.

- **Windows 98 didn't recognize some devices during our upgrades, including COM ports.**
- **If you have a removable mass-storage device, such as a Zip Drive, Windows 98 might not recognize it until you reboot.**
- **Sometimes Windows 98 goes into sleep mode when left idle too long, and it may not revive for 60 to 90 seconds, regardless of your previous settings.**

▶ TIP Before you upgrade, be sure to have current versions of all your hardware device drivers handy. This will help solve the number one upgrade problem.

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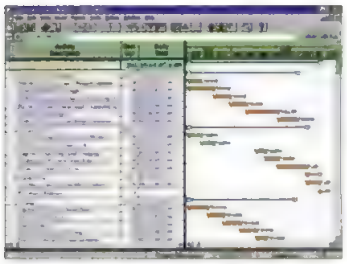

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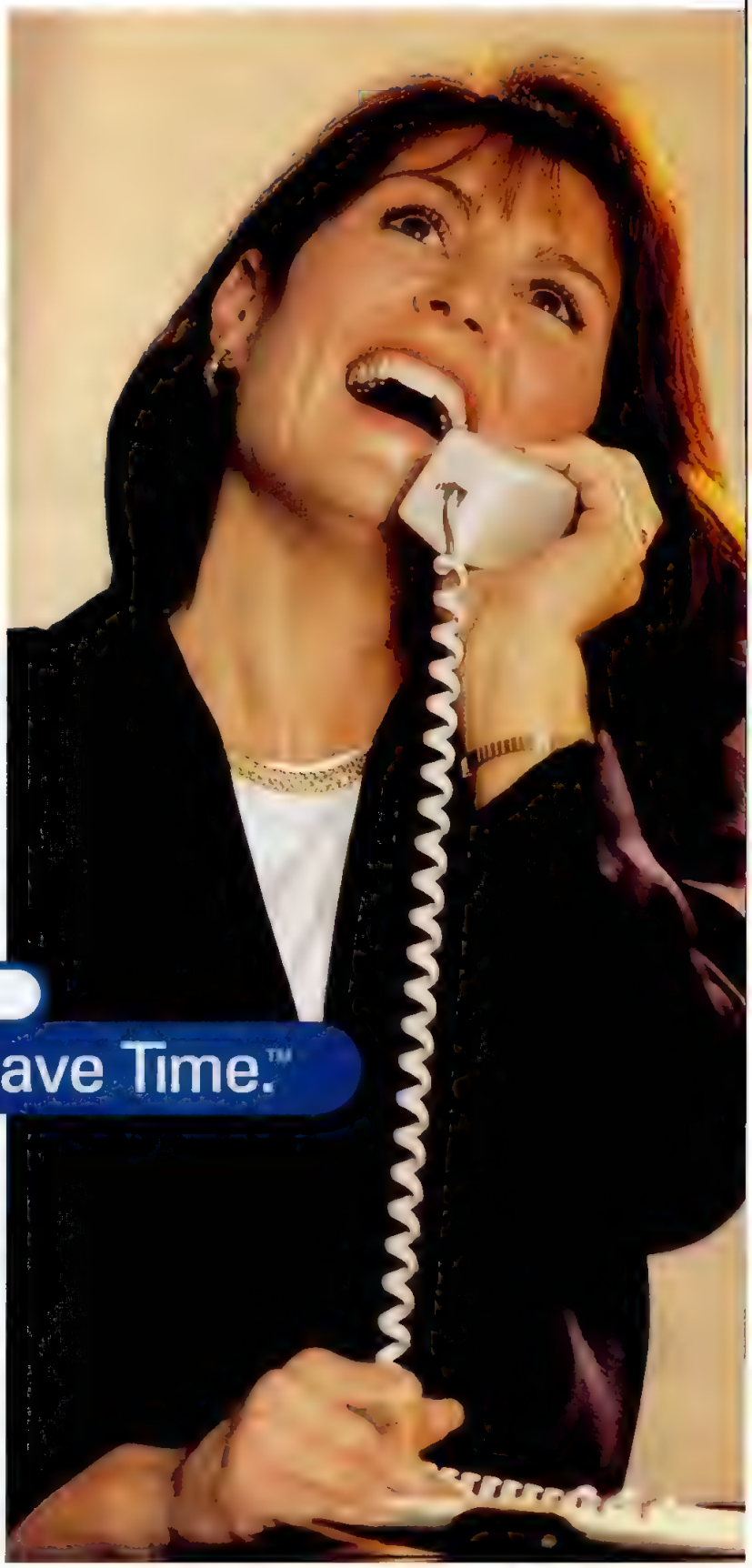

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From the Things We'd Like to See Dept....

Windows 98 is not our "dream" OS. Here's what's on our wish list.

BETTER MULTIMEDIA Microsoft's new multimedia architecture for high-end PCs, code-named "Chrome," promises much better quality video performance. It may give regular folks a reason to buy more system for gaming and entertainment than they'd otherwise need.

MORE STABILITY Windows 98 is more stable than Windows 95, but adding the NT kernel would give it the kind of stability a consumer OS needs. At the same time, you'd still need the Plug and Play features and the simpler installation of Windows 98. The trade-off would have been losing DOS compatibility (particularly with older applications and device drivers).

BETTER NETWORKING When you consider how important the PC is in running a small business and how the home is getting increasingly more wired, setting up a small LAN is still too hard. There ought to be a wizard to walk you through all the necessary steps.

EASIER-TO-LEARN INTERFACE New users still struggle to learn the Windows double-click metaphor, especially since the Web uses single-click. The single-click interface in Windows 98 would be more appealing if it had been used more uniformly. For instance, dialog boxes don't follow the "browser" metaphor. Without this level of integration, Microsoft was right not to make it the default.

EASIER TO USE We're not looking for BOB, but Microsoft needs to hide some of the complexities of the Windows OS for the next wave of consumers, who will make computers as ubiquitous as television sets. It's still too easy to screw things up and not know why. Not displaying system files when you open the \Windows folder is not enough. Speech recognition may be the breakthrough we're looking for.

be better in Windows 98—only that it wouldn't be degraded overall, even with new features introduced.)

As a result, we think you need to weigh the pros and cons of an upgrade carefully. Although Windows 98 is the right choice for most new consumer or small-business machines, we think only those who need some of the new features should upgrade systems that are currently working well.

WHAT'S OLD IS NEW AGAIN

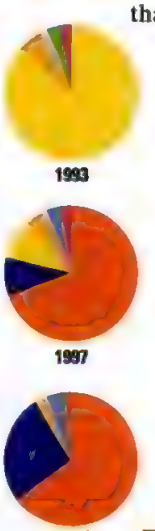
Many "new" features in Windows 98 have been road tested in service releases or as separate products in the last three years and are now collected in this new upgrade. Nowhere is this more evident than in the user interface. The basic UI looks much like what you already have if you installed Internet Explorer 4.0 on top of Windows 95—and not altogether different from what you're used to as a Windows 95 user.

The changes include the integration of the browser with the operating system, so that you can choose to look at your local and network drives through a Web-style browser interface, complete with back and forward buttons. This integration has been controversial, but speaking strictly from a product standpoint it works pretty well. Windows 98 seems more stable than Windows 95, and you can still install Netscape Navigator or Communicator if you choose. On the user interface front, Windows 98 offers subtle improvements, including more customization options (such as turning off all of the Web integration functions), but you won't see a big change.

OS Market Share 1993–2001

The worldwide OS market: yesterday, today, and tomorrow. Expect Windows NT to become more prominent, while consumer Windows remains level.

	1993	1997	2001[1]
Windows 95/98	N/A	69.4%	65.0%
Windows NT Workstation	N/A	9.2%	26.2%
16-bit Microsoft Windows, DOS[2]	85.7%	10.0%	0.6%
Mac OS	6.7%	4.6%	1.9%
Unix	1.5%	1.0%	0.5%
Linux	N/A	2.4%	3.3%
OS/2 Warp	3.0%	0.8%	1.2%
Other[3]	3.0%	2.7%	1.4%



(1) Projected.
(2) DOS includes Microsoft, IBM, and DR versions.
(3) Includes Amiga, BeOS, BSD/OS, and country-specific OSs.
N/A—Not applicable: This operating system did not exist in 1993.
Source: IDC.

BETTER HARDWARE SUPPORT

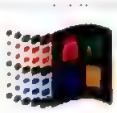
Perhaps the most important change in Windows 98 is improved support for USB and IEEE 1394 (FireWire) peripherals, although many users who have such devices already have support in Windows 95. Some vendors have told us that the release of Windows 98 means they'll likely offer less support for Windows 95, effectively forcing users to upgrade to use the devices.

On our tests, we found that USB did indeed work better under Windows 98. Still, some devices require separate drivers, much the way that some printers install automatically under Windows 95 and 98, while others require a driver from the vendor.

MORE DISK SPACE, LESS WAIT

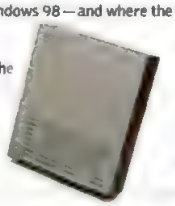
But the most compelling feature in Windows 98 is the conversion to a FAT32 hard disk format. Although FAT32 became standard with the more recent versions of Windows 95 that shipped with new machines (known as OSR2), Microsoft did not include a conversion utility from FAT16 to FAT32. FAT32 allows larger hard disk partitions and more efficient storage of data. On our tests, we were able to reclaim as much as

The History of Windows



Microsoft built a software empire on the back of its Windows operating system. Here's how we got to Windows 98—and where the Microsoft OS is going.

October 1981
PC-DOS 1.0 ships with the new IBM PC. Microsoft ships MS-DOS shortly afterwards and licenses MS-DOS to all comers.



January 1983
Apple releases the Lisa, one of the first microcomputer with a graphical user interface. With unreliable hardware and an average price tag of $10,000, the Lisa is a failure, but it spawns the more affordable Macintosh a year later. The Lisa and the Mac offer what DOS devotees derisively call the WIMP (windows, icons, mice, pointers) interface, as well as folders and long filenames—features that begin to come to Windows with Version 2.0. Some are not fully implemented until Windows 95.

March 1983
MS-DOS 2.0, a substantial rewrite, introduced support for hard disks, larger programs, installable device drivers, and a new, Unix-like hierarchical

A closed network is an oxymoron.

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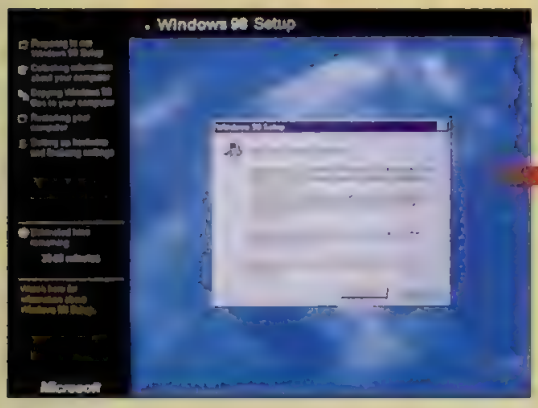
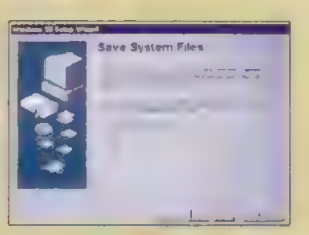
A Walk-Through of the Windows 98 Upgrade

These are the screens you need to pay attention to when you're moving your system from Windows 95 to Windows 98.

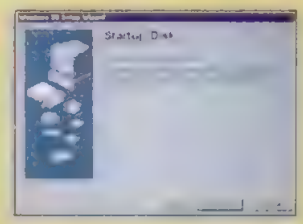


1 The start-up screen for the upgrade/installation process gives the user an overview of what steps the application will take to install Windows 98. The time estimate seems always to be the same, 30 to 60 minutes, regardless of the speed of the equipment on which the OS is being installed. For slower hardware, this estimate may be quite optimistic.

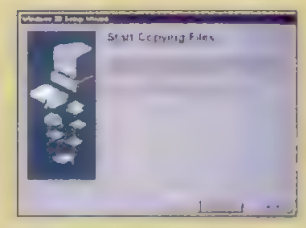
2 If you have the available hard disk space (approximately 80MB, despite this screen's indication that it needs only 50MB), you should let the upgrade process save your current system files. This will let you uninstall Windows 98 (from the Add/Remove Programs Control Panel applet) if you can't get it working to your satisfaction.



3 You can skip the creation of a start-up disk (click on Next, then Cancel at the next screen), but it's better to have one. The start-up disk includes all the files necessary to boot the system, plus generic CD-ROM drivers that let you use most CD-ROM drives. The disk can be used to boot other machines as well as the system on which it was created.



4 At this point the installer will begin to copy files from the CD. Even though it has already checked for available disk space (it needs 100MB), the installation could fail here if the local disk doesn't have at least 120MB of free space. The installer will tell you how much additional space is needed. You can launch Windows Explorer and delete files to make room without having to restart the installation.



15 percent more of our hard disk space just by upgrading to FAT32.

To complement FAT32, Microsoft has added new technology to its disk defragmenter; this technology monitors the order in which programs load components and arranges the files on your hard disk so that they load faster. Our tests showed that in order to see any demonstrable results, you have to convert to FAT32 and be running Windows 98. Application load times for popular programs such as Lotus Notes and Microsoft Word dropped by as much as 69 percent. This doesn't translate into much real time—the biggest change we saw was less than 8 seconds—but these kinds of improvements give users the sense that their systems are running more smoothly.

PERCEPTION IS REALITY

With Windows 98, Microsoft didn't focus on overall performance but instead worked on bottlenecks, such as application loading, start-up, and shutdown times.

Many of us involved in the story perceived that Windows 98 did shut down somewhat faster than Windows 95, although we didn't see that on every machine every time in our labs testing. In addition, Microsoft says start-up will be much quicker on systems enabled with ACPI, but such systems are not yet ready for testing.

Our Contributors: MICHAEL J. MILLER is the editor-in-chief of *PC Magazine*. EDWARD MENDELSON, JAN OZER, STEVE RIGNEY, BARRY SIMON, and M. DAVID STONE are contributing editors, and NEIL J. RUBENKING is the contributing technical editor of *PC Magazine*. NEIL RANDALL is a frequent contributor to *PC Magazine*. BEN Z. GOTTESMAN and LARRY SELTZER are technical directors of PC Magazine Labs. GAIL SHAFFER is an executive editor at *PC Magazine*. DOUG BEIZER is a staff editor, EMILY COHEN is an editorial researcher, and NANCY SIRAPYAN is the librarian at *PC Magazine*. DAVID CHERNICOFF is a principal of Digital Performance Consulting in Washington Crossing, Pennsylvania. KEITH PLEAS writes and speaks on advanced operating system and development topics. JAY MUNRO was the project leader, and DAVID LIDSKY was the associate editor in charge of this story.

file system. Still has cryptic eight-character filenames and a text-mode interface.

October 1983
VisiCorp., an offshoot from the company that created the groundbreaking DOS spreadsheet VisiCalc, releases VisiOn, an "integrated environment" that's the first GUI for the PC. It requires 512K of RAM and a hard disk—still a cutting-edge setup at this point.

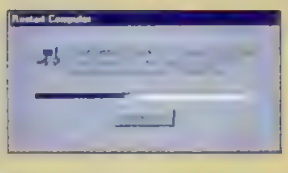
November 10, 1983
Microsoft announces Windows, an environment that extends the features of DOS with a graphical interface.

September 1984
GEM (Graphics Environment Manager) is announced by Digital Research. Released early in 1985, it can't run DOS apps, which hampers its viability. Both GEM and VisiOn beat Windows to market, but both suffer from same problem as the original Windows: Few applications are available for these new platforms.

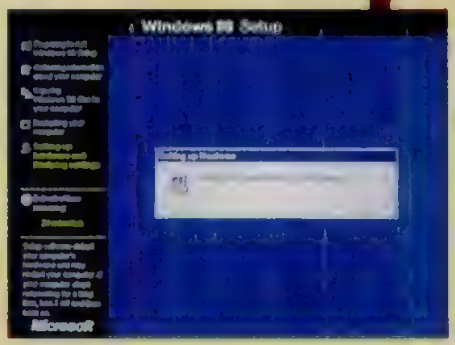
February 1985
IBM releases TopView, a text-based DOS multitasker. Only a few DOS commands can be used with TopView. DOS batch files cannot be run by TopView, which intercepts nearly all DOS interrupts. IBM promises to add a GUI to TopView but ultimately never does.

July 1985
Quarterdeck Office Systems releases DESQview, another text-based multitasker for DOS. It

5 This is the first of the screen displays that run while files are being copied. To keep you entertained, the installer will tell you how wonderful Windows 98 is and what a brave new world you are entering. This commercial ends when the system is ready to reboot.

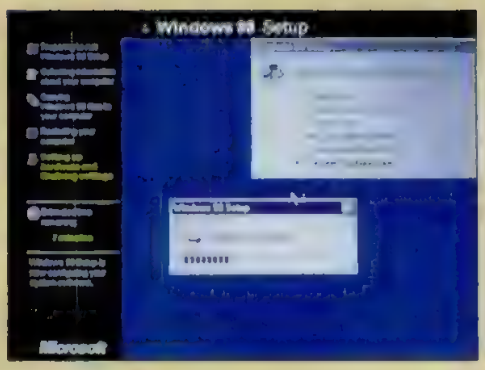


6 This is the first of three reboots that occur during the installation. If your system locks up at this point, a hard boot allows the installation to continue normally.



7 After the restart, Windows 98 will attempt to discover all installed hardware. To do this, it examines the large database of drivers that are available on the Windows 98 CD and tries to match the appropriate driver to the hardware it finds. If it can't find a necessary driver on the CD, it will use an installed Windows 95 driver.

8 As the final stage of the installation, Windows 98 walks through the setup and configuration of user interface components such as the desktop, help files, and Control Panel. The installer also begins the process of tuning application performance (organizing the hard disk and so on).



More important, the system is designed to go into a sleep mode after long periods of inactivity instead of shutting down. Resuming from sleep mode took up to a minute and a half on some systems we tried but was still faster and simpler than restarting both Windows and the applications. This feature will also change power management on ACPI-compliant laptops.

UTILITY PLAYER

Each version of Windows brings improvements to the system utilities, and Windows 98 is no exception. All of its utilities improve on those in Windows 95, but they won't make you forget third-party utilities.

Along with new versions of the basic defragmenter and ScanDisk, there is a new disk-cleanup utility that clears out temporary files and the recycle bin. We're also particularly happy with the System File Checker, which looks for important files that could be overwritten by other products; and the Version Conflict Manager, which checks for files that could be overwritten by newer products. Such changes have often caused problems in Windows 95, and while this feature is for sophisticated users only, it's a good step in the right direction. A new utility checks the Internet for Windows upgrades and new device drivers.

GRADING THE UPGRADE

If you decide to upgrade, you're likely to find that the process occurs without incident. Our upgrade testing covered a variety of situations. Most upgrades went smoothly, but we did experience several minor snags: With removable mass-storage devices (such as Zip Drives), Windows 98 required a reboot after the upgrade before it recognized the devices in every situation we tried. In several cases, the same was true of audio subsystems. While this might be momentarily disconcerting, it shouldn't cause a problem for most users.

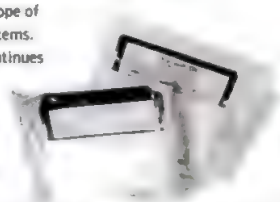
More troubling were things that just didn't work right after the upgrade. We had trouble with a 3Com Impact external ISDN terminal adapter on one, a COM port connected to a digital camera on another, and a DSP-based internal modem on an IBM ThinkPad 600. Each required reinstallation, and in the third case we're waiting for a new BIOS to fix the problem.

succeeds for a time with a limited audience. Quarterdeck makes many attempts to rally developers rally around DESQview as a platform only to see them fail. Quarterdeck finally gives up after Windows 3.0 becomes the standard.

November 20, 1985
Windows 1.0 ships. Version 1.0 enables users to work with several programs at the same time, switching easily between them without having to quit and restart individual applications. But windows on Windows cannot overlap, crippling usability. Not enough software is written for Windows 1.0, and it fails to take hold in the marketplace.

January 1987
Aldus PageMaker 1.0 ships with a Windows 1.0 "runtime," providing the first WYSIWYG capabilities for publishing on the PC. The popularity of desktop publishing applications, coupled with the release of the laser printer, helps Windows gain entrée into desktops.

April 1987
IBM and Microsoft announce OS/2 1.0, the Great Blue Hope of operating systems. Microsoft continues Windows development but hedges its bet on the next-genera-



Windows 98 the Hard Way

Microsoft quite naturally claims that Windows 98 is chock-full of new features. Here's a guide to separate the truly new from the tried-and-true.—Neil Randall

New Windows 98 Feature	Enhancement	How to get it without Windows 98
IE4/Active Desktop/ Internet programs	New browsing functionality (every Explorer window is a browser). Has Web-like, single-click user interface from the desktop through the system windows. Offers Outlook Express for mail, NetMeeting for conferencing, and NetShow for streaming audio/video.	Available on CD or as a free download at *www.microsoft.com/ie/download*.
FAT32	A 32-bit file system; frees disk space by using smaller clusters.	Available in OSR2 release of Windows 95; never available as an upgrade. To see if you have OSR2, go to System Properties in Control Panel; under the General tab, the Windows 95 version will display 4.00.950 B.
FAT32 Conversion Utility	Converts existing FAT16 partitions to FAT32; Windows 95 OSR2 did not have this capability.	PowerQuest's PartitionMagic ($69.95 list) included a conversion to FAT32 in Version 3.0 (early 1997) and also let you convert the other way (FAT32 to FAT16), which Windows 98 doesn't.
Bug fixes	Contains more than 3,000 bug fixes (according to Microsoft).	Service Pack 1 (available from *www.microsoft.com/windows/downloads/default.asp*) corrected a lot of bugs. Others can be fixed via downloads from *www.microsoft.com/windows/downloads/contents/Updates/W950SR2/Features.asp*.
Universal Serial Bus support	New device interface makes installing hardware peripherals much easier. Windows 98 supplies drivers for many USB devices and controllers.	Limited availability in OSR2.1. Individual vendors have offered Windows 95 drivers since USB ports began appearing on motherboards.
Maintenance Wizard	Automates hard disk error checking, defragmentation, and cleanup activities such as deleting temp files. Can also control start-up programs.	Not available in Windows 95 per se; similar tools are available in third-party utility packages such as Norton Utilities. You can replicate some of the functionality with Windows 95's task scheduler.
Registry Checker	Finds and fixes registry problems; creates automatic backups of the registry.	Available in shareware offerings and some utility packages for Windows 95, such as Norton Utilities and Network Associates' Nuts & Bolts.
DirectX 5.1	Supports the most recent set of Windows multimedia features.	Available for download from *www.microsoft.com/directx/default.asp*.
WebTV for Windows	Supports TV viewing in Windows 98, as well as enhanced TV through Web sites, interactive programs, and the like. Will support only the ATI All-in-Wonder board initially.	Enhanced TV from Intel Intercast, available from a number of TV tuner card vendors, including ADS Technology, Aims Lab, Diamond Multimedia, Hauppauge, and STB.

THE VERDICT

Although we encountered fewer problems with Windows 98 upgrades than with others, any upgrade is risky. If your current system runs fine, Windows 98 will provide some incremental improvements, but the risk of upgrading may outweigh them.

We recommend the upgrade only for people whose systems aren't as stable as they would like, or for those who want FAT32 or some of the other new features—and who have the experience to deal with the occasional glitch in the upgrade process. Also, anyone looking to use USB devices should consider upgrading.

For new systems, Windows 98 is likely to be a nice improvement—one that should allow for a more stable OS, faster performance in some cases, and better support for new hardware. Unless you're in an organization that has standardized on Windows NT, putting Windows 98 on a new computer makes perfect sense.

The Upgrade Experience

Prior to the release of Windows 98, Microsoft claimed that this upgrade would be the smoothest upgrade yet seen for any previous version. The company even claimed that the reason it didn't release the product in 1997 and call it Windows 97 was to guarantee that users of 16-bit Windows (3.*x*) would have a smooth upgrade path.

We upgraded 15 computers specifically for this piece, in addition to many others in the process of producing this article. In our testing, we found that on the whole, the Windows 98 upgrade went smoother than any previous one. That doesn't mean, though, that this upgrade is without its problems.

Every system we tested was ultimately able to upgrade successfully, but not without a few bumps on the way. Less-experienced users who don't regularly tinker with their PC should be wary of upgrading without some assistance; those with more troubleshooting skills should be able to handle most problems that arise.

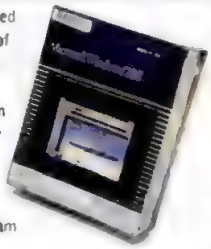
We upgraded a wide variety of computers running Windows 3.1, different flavors of Windows 95, or the commercially available beta version of Windows 98. The 15 computers we upgraded ranged from older 90-MHz Pentiums to newer Pentium II machines—both desktop and notebook systems. We did both clean installs and upgrades. And systems running non-Intel *x*86 processors, such as the AMD K6, were also tested. Microsoft's recommended minimum system is a 486 DX2/66, at least 16MB of RAM, and anywhere from 195MB to 295MB of available disk space.

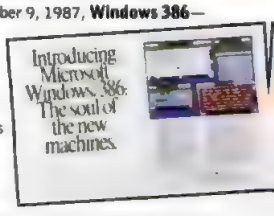
Many of the problems we ran into were related to Windows 98 neither recognizing nor enabling previously installed hardware devices. So before you upgrade, make sure

tion PC operating system. OS/2 1.0 doesn't have a GUI, and it finally fails because of a lack of applications and hardware support, poor support for DOS apps, and confusion over whether you need to buy a PS/2 to use it.

October 6, 1987
Excel for Windows 2.0, the first viable GUI spreadsheet for the PC, enters the market to challenge the hegemony of Lotus 1-2-3. Excel helps Windows gain legitimacy, but its high resource requirements and reliance on Windows device drivers make it a pale challenger at this point.

December 9, 1987
Windows 2.0 ships. It uses a system of overlapping windows rather than the tiled windows scheme of previous versions. Can also utilize protected mode on 80286 systems or better, allowing programs to break out of the DOS 640K program size barrier. In June 1988, when Version 2.1 is released, it is renamed Windows 286. Also on December 9, 1987, **Windows 386**—a version of 2.0 optimized for Intel's latest chip—is released. It has some market impact, but





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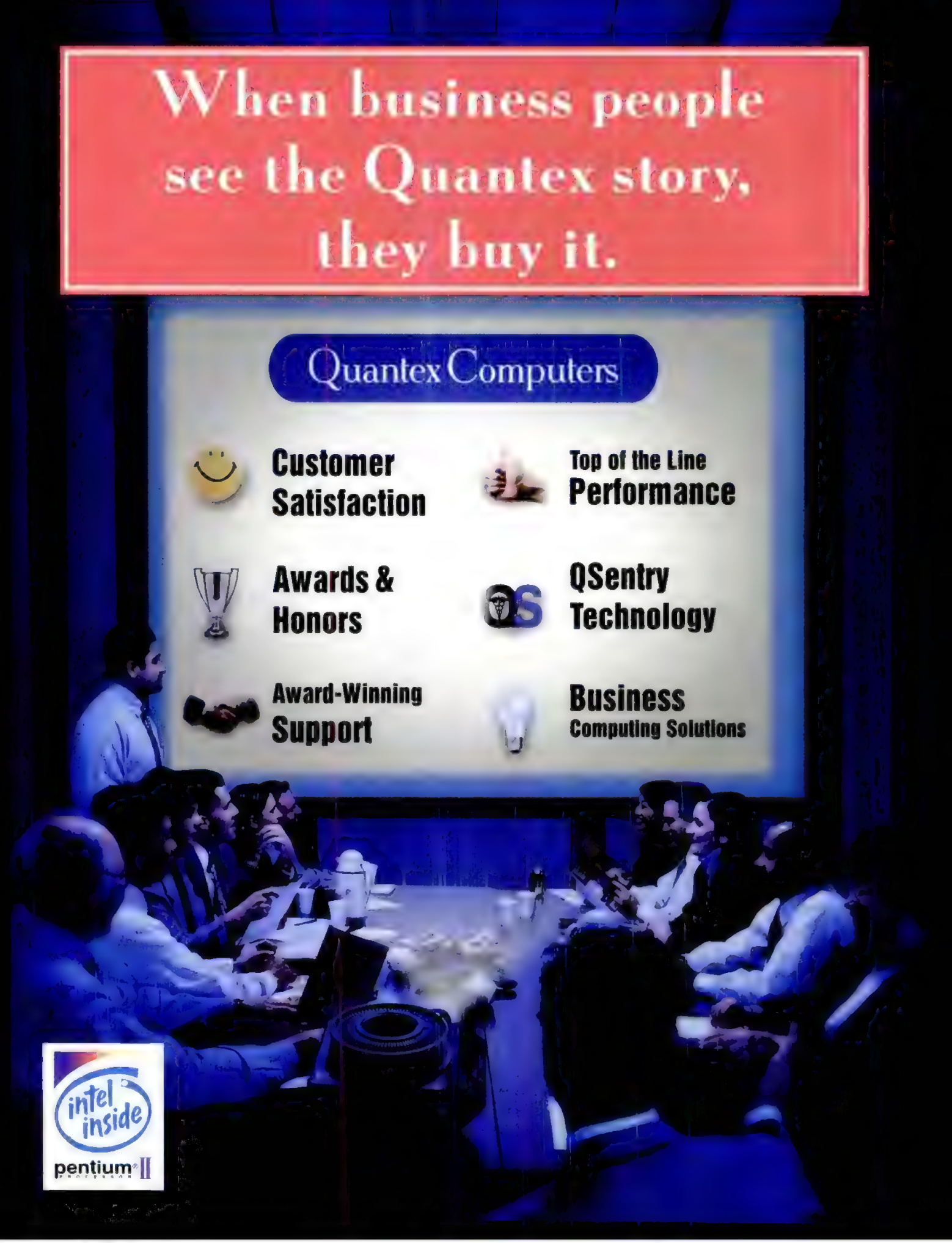

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OVERALL RANKINGS
Technical Support Survey

PC VENDOR	GRADE
Quantex	Excellent
Dell	
IBM	
Compaq	Good
Gateway 2000	
Micron	
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Toshiba	
Digital	Poor
Packard Bell	

Windows Magazine, 8/97

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that you have copies of the latest drivers for all your hardware devices. Rebooting our machines and reinstalling the drivers remedied many of the snafus we encountered. Here are the things you'll want to look out for if you decide to upgrade.

REMOVABLE MASS STORAGE

In almost every upgrade scenario that included high-capacity removable media devices such as Jaz, Zip, and SparQ drives, either Windows 98 failed to correctly install/upgrade the device during the initial upgrade or its presence caused the system to freeze up. In nearly every case, however, the upgraded system did discover the device as new hardware during the first reboot cycle after the upgrade. At that point, we were prompted for the Windows 98 CD or the manufacturer's driver disk. In every case, we were able to get the drives working with little trouble after that.

NEWBIES NEED NOT APPLY

A number of hardware devices that worked properly under Windows 95 started exhibiting strange behaviors after the Windows 98 upgrade. Fixing some of those problems probably exceeds the capabilities of all but power users.

On one Windows 95 test system, a 3Com Impact external ISDN terminal adapter simply stopped working. Windows 98 detected it and reported its presence correctly, but it just didn't work. Deleting it from the system configuration and reinstalling it, with a fresh copy of the drivers, solved that problem.

Another Windows 95 system had drivers for an Olympus digital camera installed. After the upgrade, the COM port to which the camera was connected disappeared. A check of the system BIOS indicated that the port was configured to the standard COM2 address. Resetting the system BIOS to auto-detect the COM ports allowed the new hardware to be detected and the COM port to be installed correctly.

Windows 98 Exclusives

WINDOWS UPDATE Online updating system. Goes to MS site and checks for installed and updatable Windows 98 components and drivers. Similar system previously available for IE4 but not for all of Windows 95.

ACPI SUPPORT Low-level support for power management and Plug and Play. Needs hardware and applications to take advantage of it.

HTML-BASED HELP Replaces existing Help with linked, indexable, searchable HTML documents. Unavailable in Windows as a whole previously, but available in IE4 and Netscape Communicator 4.0.

TROUBLESHOOTING WIZARDS Step-by-step interactive assistance with solving system problems. Windows 98 has 15 wizards; Windows 95 has a few, but they're less interactive.

VERSION CONFLICT MANAGER Looks for version conflicts in the programs installed on the system. Will install updated files and store originals for user-controlled return to previous versions. Only partially available in third-party utilities for Windows 95.

WINDOWS DRIVER MODEL Controls design of device drivers. Let's device manufacturers use same driver for Windows 98 and NT 5. Eases development for hardware vendors.

WINDOWS SCRIPTING HOST Enables creation of scripts to automate activities, combining VBScript, JavaScript, and other scripting languages. Particularly useful for network administrators. Available in IE4, but this is the first available throughout the OS.—*NR*

CASE OF THE RECALCITRANT PRINTER

We ran into perhaps the most perplexing problem with a home-built AMD K6 233-MHz system that was set up for family use. The computer had been initially set up with the beta of Windows 98 that Microsoft sold with the beta of the Windows 98 Resource Kit. We expected trouble with the 16-bit Windows 3.1–era drivers for an old scanner, but the scanner continued to work flawlessly after the upgrade. But while attempting to print using Microsoft Greetings Workshop and Mattel's Barbie Print 'n Play software, the system slowed down, and eventually the applications faulted. Printing from other applications worked correctly.

As we were trying to diagnose the cause of this behavior, we killed a session of Greetings Workshop as soon as it started to slow down. The next error message we received was from the Windows Print Spooler, telling us that the spooler had faulted and asking us if we wanted to save our print jobs.

Taking our cue from this error message, we uninstalled the printer driver software (for a Lexmark 2030 ink jet) and rebooted the system. Windows 98 detected the printer during the reboot and prompted us for the driver disk. After we reinstalled the drivers and restarted the system yet again, the printing problem was gone.

This is not something that most users should be expected to do, and calls to technical support would have been made long before an inexperienced user would have run into that print error by accident. Snafus such as this are the reason you should approach the upgrade with caution.

HIGH ENERGY

One annoyance that cropped up on two of our test systems was that Windows 98 decided on its own to enable energy saving on systems where it was not previously configured. It both cases, the OS set the monitor and hard disk time-outs to 15 minutes. When we returned, the system appeared to have died. Moving the mouse or hitting keys seemed to have no effect, so we hard-booted the computer.

This brought up the ScanDisk screen, which told us that Windows had been improperly shut down. We later discovered that the energy-saving configuration had been enabled, and that it took a good 60 to 90 seconds for the system to power up after putting itself to sleep.

mostly, by letting users multitask DOS programs in the 386 chip's "virtual machines," it lays the foundation for much of what emerges in Windows 3.0.

June 1988
Digital Research launches DR-DOS, which the press considers superior to MS-DOS because of its powerful utilities. But DR is distracted from further development by the need to patch its OS to work with Windows, and DR-DOS never garners much market share.

October 31, 1988
IBM's OS/2 1.1 with Presentation Manager ships. The first OS/2 with a GUI, 1.1 is a major upgrade to OS/2 1.0, but it still has insufficient support for popular DOS applications and existing hardware. OS/2's problems encourage Microsoft to continue Windows development and IBM continues to develop OS/2. Sometime later, IBM complains that Microsoft is focusing on Windows, and the two part ways for good.

December 1988
Samna Ami, the first Windows word processor, ships. Users can edit using fonts that resemble print fonts and view margins as they actually appear. WordPerfect remains the dominant word processor, but Ami has much influence, if little impact, on the market. Microsoft Word for Windows will follow soon.

May 22, 1990
Windows 3.0 ships; has significant usability improvements. Program Manager

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FINALLY

In the event that you don't find Windows 98 to be what you had hoped, this is the first version of Windows that you can uninstall just like any other application. You'll find the uninstall option in Add/Remove Programs in the Control Panel. One caveat is that you have to have backed up your system files during the upgrade and not yet converted your hard disk to FAT32. We were able to roll back a system to its previous state with no difficulty.

We had no problems when upgrading systems on either NetWare or NT networks. Both IPX and TCP/IP running on Windows 3.1 and Windows 95 migrated correctly to Windows 98. Given the number of systems that we upgraded and the fact that we selected systems based on their differences, we had a relatively small number of problems. Nevertheless, you should take the necessary precautions of backing up your system files and having all the hardware drivers you need before undertaking an upgrade.—*David Chernicoff*

The Interface

Whether you're running Internet Explorer 4.0 with Active Desktop or not, the transition to Windows 98 should be smooth when it comes to your interface experience. For Active Desktop users, the system will look almost identical after you upgrade to Windows 98. And for everybody else, by default Windows 98 will look pretty much like its predecessor.

You'll find some of the new features helpful, such as the customizable toolbars embedded in the taskbar and the menu that pops up when you right-click any Start Menu item. You might find others annoying, such as the Channel Bar, in which you select Internet content that you want to have pushed to your browser or desktop.

You can turn on Active Desktop and the single-click interface to get the full Windows 98 experience.

YOUR DEFAULT DESKTOP

When you first boot up Windows 98, the most obvious changes are cosmetic. By default, 256-color icons are installed instead of the 16-color icons in Windows 95. Application title bars display a color gradient instead of a solid color.

Other changes are more functional: A new My Documents desktop icon and the Start/Documents/My Documents shortcut lead to the folder that Windows sets up as your default repository. The Start Menu also has new Favorites and Log Off items. If you install Windows 98 on a clean partition or buy it on a new computer, you'll find that the Windows 95 Inbox icon is gone, although some third-party applications (such as Corel WordPerfect Suite) install it for you.

Explorer has a Web-style interface, with complete additional file information in the left frame.

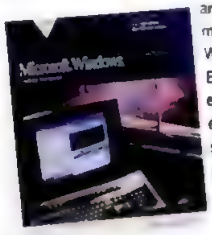
NEW BROWSER-LIKE EXPLORER

The most noticeable changes are in Windows Explorer, which now borrows features from Web browsers. Forward and Back buttons on the toolbar redisplay folders in the way that browser buttons redisplay Web pages. Drive lists and folder lists appear by default in a view that resembles a Web page with a frame: A narrow panel on the left shows general information, and a wider panel on the right lists drives, folders, or files. When a file is selected in the right panel, its date and size appear in the left panel. If an image file or Microsoft Office document is selected, a thumbnail preview also appears. Drive windows include a pie chart of disk usage.

When you open the Windows folder, instead of a file list you see a warning against interfering with system files, and you have to click a link before it displays any files. Designed mostly for new users, these Web-style effects can be turned off by advanced users—or customized in HTML.

To select a file using another Web-like feature of Windows 98, you can just hover over it with the mouse and launch it with a single click. Despite Microsoft's publicity about this new behavior, this feature is switched off by default and must be turned on from the Start Menu's Settings|Folder Options dialog. New users should find this new behavior easy to learn, but experienced users may feel it makes Windows seem hyperactive until they get used to it.

If you prefer to have a new interface without upgrading your operating system, you can get some of the look and feel of Windows 98 by installing IE4's Active Desktop in Windows 95. Although Windows 98 *looks* like IE4's Active Desktop,



and the icon setup work much better than the old Windows 2 MS-DOS Executive. File Manager is new. Developer enhancements kick-start the Windows software boom. Stability is less than ideal, but Windows 3.0 immediately dominates the market thanks to widespread third-party hardware and software support and preloading by PC vendors. Microsoft's commitment to making Windows work finally pays off.

November 1990
GEOS 1.0, another GUI for DOS, is introduced but never emerges as a true Windows competitor. Although PC Magazine and some other publications laud GEOS's technical merit, no software is available for it. Developer software doesn't ship until six months after the OS.

March 1992
OS/2 2.0 begins shipping. It offers good DOS/Windows 3.x support but is burdened by the complicated Object-Oriented Workplace Shell and by resource requirements that are heavy for the time. OS/2 still lacks widespread driver and third-party software support, and Windows emerges as the market leader.

April 6, 1992
Windows 3.1 is released. It contains numerous bug fixes, is more stable, and adds a few new features, including scalable TrueType fonts. Windows 3.x becomes the operating system most often installed on U.S. PCs and will remain so into 1997.

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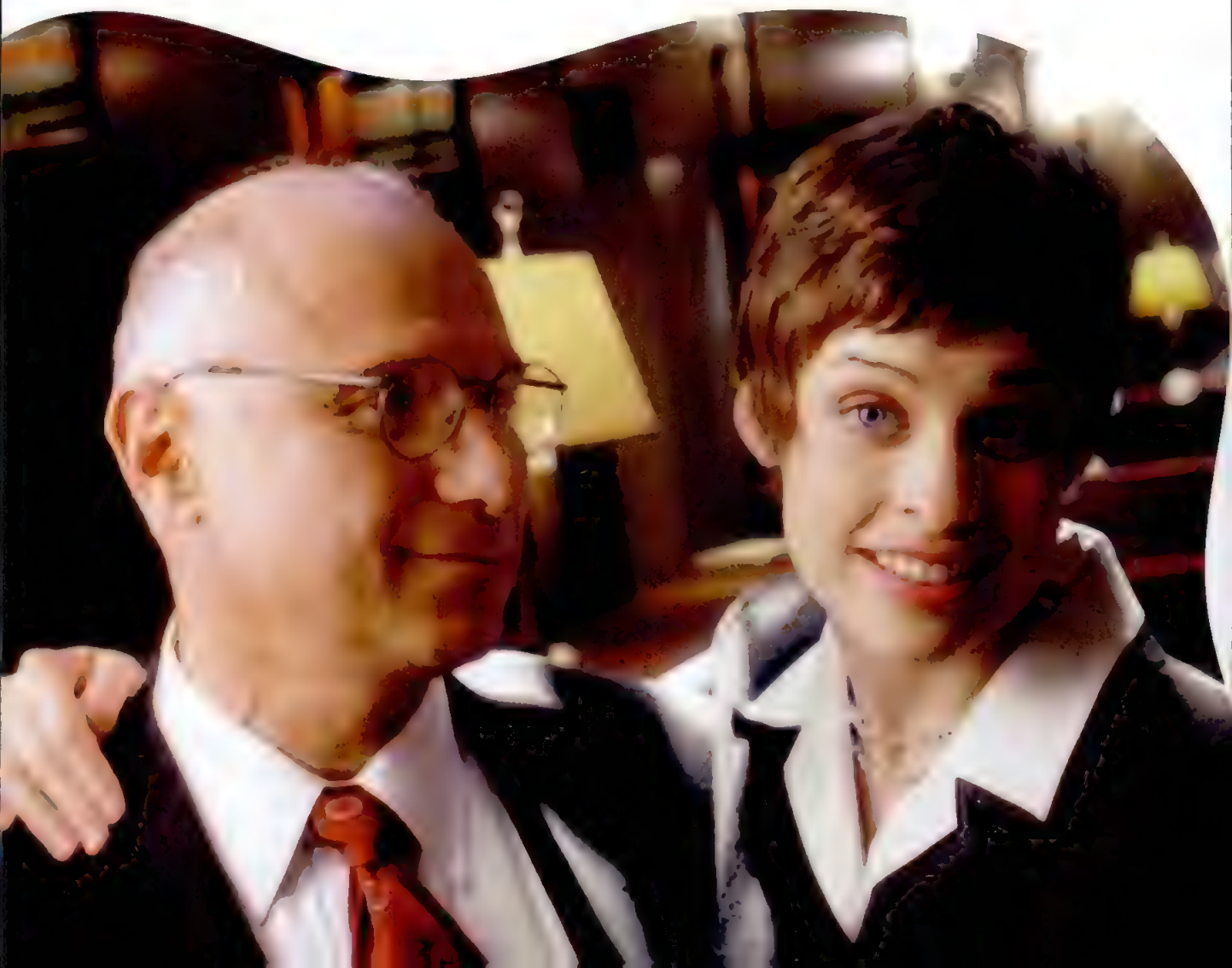

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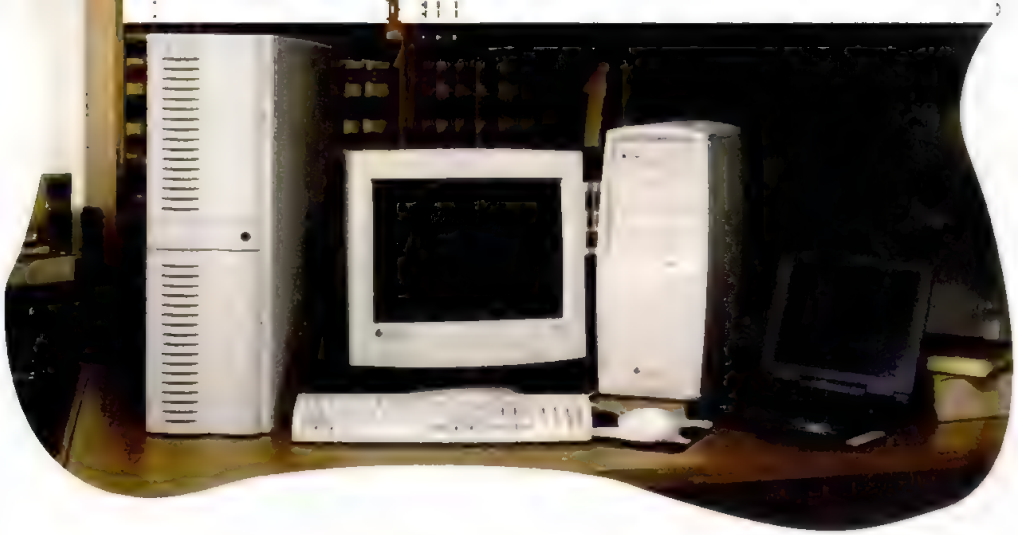

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Windows 98 includes many internal improvements that are unrelated to the user interface and that you won't get until you upgrade.—*Edward Mendelson*

Performance

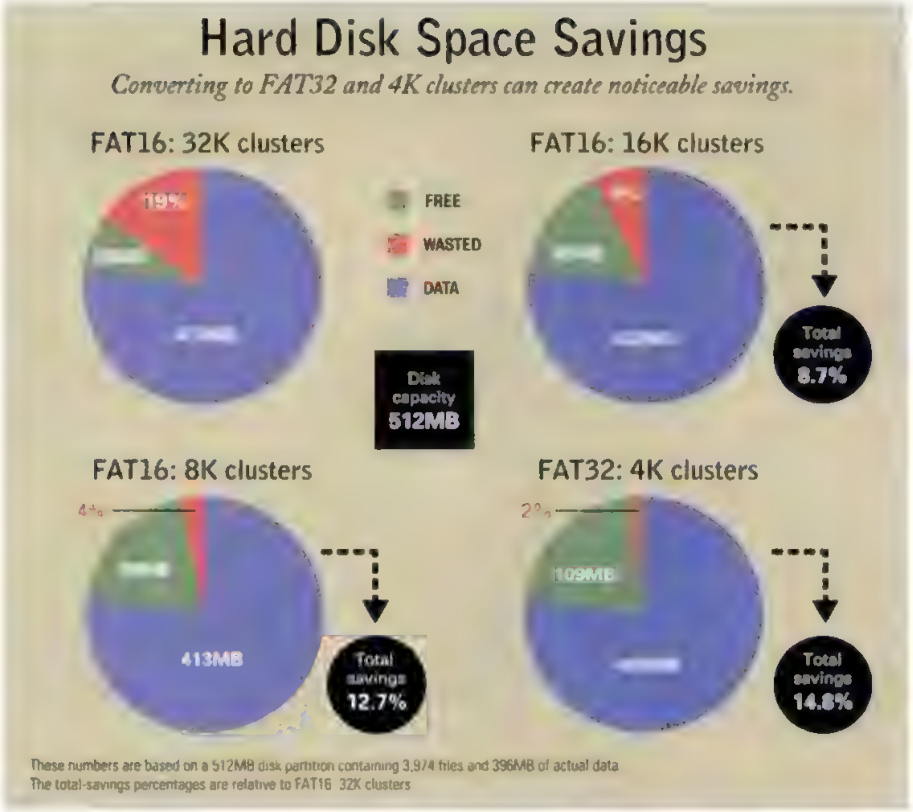
With Windows 98, Microsoft says it did not set out to make significant improvements in general system performance. Our tests bear this out. We saw no improvement in startup speed, although shutdown often seemed faster with Windows 98. The most dramatic improvement we saw was in application loading. Applications frequently loaded twice as fast with Windows 98, which makes for a better user experience.

DISK-SPACE SAVINGS

Windows 98 supports a 32-bit File Allocation Table (FAT32) file system, which means it can store files in smaller clusters, a more efficient method than with 16-bit FAT (FAT16). As hard disks grew larger, the inefficiencies of the existing FAT16 file system quickly became apparent. Because FAT16 couldn't handle more than 65,536 clusters, the only way to keep pace with larger disks was to enlarge the size of each cluster. Any partition greater than 1GB in size uses 32K clusters. A 1-byte file would use up the same 32K that a 30K file requires. A 33K file would occupy 64K of disk space. FAT32 uses 4K clusters up to 8GB.

To tackle this problem, in late 1996 Microsoft introduced FAT32 in OSR2, an interim upgrade to Windows 95 provided to manufacturers only for incorporation on new computers. Windows 98 makes FAT32 available to all users and provides an upgrade utility to convert your existing FAT16 drive, something OSR2 lacked.

To illustrate the differences between varying cluster sizes, we took a 512MB partition and installed Windows, Adobe Photoshop, Microsoft Office, and Netscape Navigator. In all, we stored 3,974 files totaling approximately 396MB on the hard disk. Using FAT16 and 32K clusters, the files occupied 473MB of space, wasting 19 percent. Using FAT32 and 4K clusters, the same files occupied 403MB, only about 2 percent waste.



APP LOAD ACCELERATION

Although FAT32 is designed to improve the efficiency of disk usage, it also can help improve application loading time. To significantly improve application load time, upgrade to Windows 98, convert to FAT32, and periodically run Windows 98's Maintenance Wizard. We didn't see a dramatic difference between Windows 98 and Windows 95 systems with both using FAT16, nor did we see much improvement upon converting to FAT32 under Windows 95.

We tested application loading—using both FAT16 and FAT32 file systems—on three different systems: one representing a PC that was cutting-edge around the time of Windows 95's release, one average desktop system, and one current top-of-the-line machine.

We also tested load times after running the Disk Defragmenter on Windows 95 and the Maintenance Wizard (which deletes unnecessary files, checks for hard disk errors, and defragments) on Windows 98.

HOW IT WORKS

Every time you load a program, Windows 98 monitors the exact sequence of file loads and stores this information in a series of files in the Windows\Applog directory. It also tracks which programs are loaded more often than others.

The Disk Defragmenter takes this

July 4, 1992
Microsoft announces Win32, the next-generation API for 32-bit Windows NT. The first public mentions of "Chicago" appear (the code name for what will become Windows 95), as well as talk about how the NT product will eventually supplant the existing Windows architecture.

October 27, 1992
Windows for Workgroups 3.1 ships. Integrates networking and workgroup capabilities, including electronic mail delivery, group meeting scheduling, file and printer sharing, and calendar management. Although 3.1 presages the small-LAN boom, it is a commercial failure, earning the ignominious nickname "Windows for Warehouses."

April 1993
With Version 6.0, IBM begins marketing PC-DOS separately from Microsoft. PC-DOS 6.0 incorporates a different memory manager and optimizer from the one Microsoft licensed in the original 1981 IBM PC. Novell acquires DR-DOS and rereleases it, with fancier networking, in December 1993 as Novell DOS 7.0. Both of these efforts are too little, too late, as DOS is waning in significance. All the real PC innovation is happening in Windows and non-Microsoft OSs.

Application Loading

Converting to FAT32 produces significant improvement under Windows 98.

information and reorders the individual clusters within program files so that they load consecutively, without excessive disk head movement. It also lays out the programs so that the most frequently loaded data is on the fastest part of the disk. Ironically, this creates a file system that is heavily fragmented on a logical basis, so any third-party defragmenter tools will need to be updated.

For testing, we started with a system on which about a third of the file system was fragmented, as it might be after months of heavy use and frequent application installation. We tested the load times for Adobe Photoshop 4.0, Lotus Notes 4.6, Microsoft Excel 97 and Word 97, and Netscape Communicator 4.05.

APPLICATION LOAD RESULTS

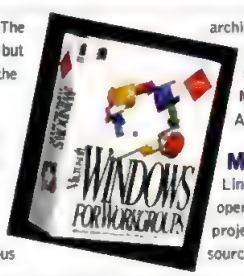
In Windows 95, the performance differences between FAT32 and FAT16 were often trivial. Interestingly, some applications loaded faster after defragmenting and some didn't. Loading Photoshop on a Windows 95 FAT16 system actually was slower after defragmenting. The same was true of Windows 98 with FAT16.

Windows 98 with FAT32 was a different story. Initial load times were about the same or slightly slower than on Windows 95 with FAT32. But after we ran the Maintenance Wizard, load times dropped drastically and consistently. On the Pentium/166 unit, the Lotus Notes load time dropped from 10 to 3.1 seconds, and Word's load time dropped from 5.4 to 1.8 seconds. On the Pentium/90, Photoshop's load time dropped from 20.3 seconds before defragmenting to 12.9 seconds after.

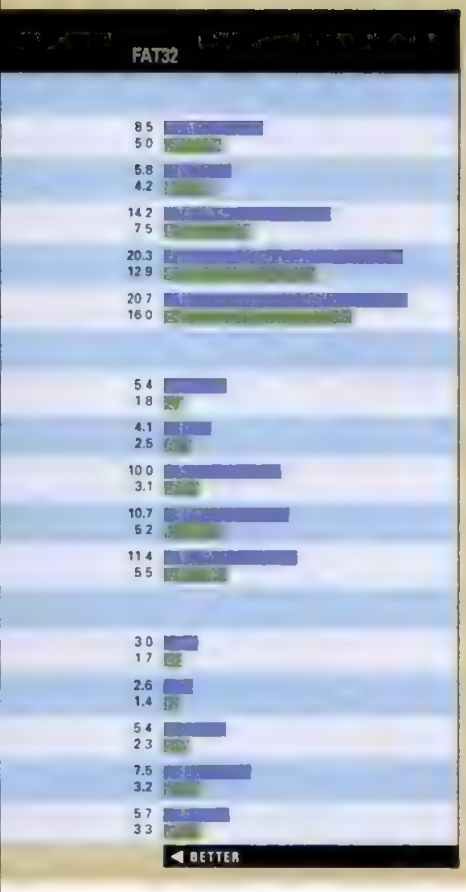
At first, a few seconds might not seem like much to save, but its importance lies in the smoothness of the user experience. We all know how frustrating it can be to wait for a big application to load, so 1.8 seconds is a big improvement over 5.4. FAT32 is worth using in Windows 98 for the performance benefits alone.

May 24, 1993
Windows NT (which stands for New Technology, although wags refer to it as Not Today, No Thanks, and Nice Try) is launched. Geared towards the power user and the server market from the start, the first version, 3.1, requires a high-end PC to run and is rough around the edges. But Windows NT is well received by developers because of its security, stability, and richer Win32 API, which makes it easier to write powerful programs. The project began as OS/2 3.0 but became a total rewrite of the code.

November 8, 1993
Windows for Workgroups 3.11 ships. Offering improved support for NetWare and Windows NT, it also slips in numerous architectural changes that improve performance and stability and later find their way into Windows 95. Much better received by corporate America this time around.



March 1994
Linux 1.0, a new multiuser Unix operating system that began as a hobby project, is released. Launches the open source code movement wherein any third party can make its own improvements and contribute them to the main product. New hardware and software can be ported to Linux quickly, often before being available for Windows. Although Linux has never had a large commercial presence, it continues to intrigue (even Netscape has mused about integrating Linux and Communicator to take on Windows NT). Indeed, Linux has become the Unix of choice on PC systems, thanks in



WINSTONE

We also tested overall system performance using the ZD Winstone 98 benchmark test program. The overwhelming result of our tests was that the differences between Windows 95 and Windows 98 were small, often within the margin of error (3 percent) and not a basis for product decisions.

This is not surprising, given that the Winstone program measures performance of an application once it is loaded, not aspects of system performance that Windows 98 specifically enhances. Winstone also installs each application immediately prior to testing it, so the application can't benefit from Windows 98's optimized defragmenting.

START-UP AND SHUTDOWN

Microsoft also claims improvement in the time it takes to start Windows and shut it down, but here our tests were inconclusive. Unlike with application load times, 2 or 3 seconds are not a lot to save in system start-up and shutdown. Some of the start-up acceleration features rely on hardware, specifically the Fastboot BIOS, which is not yet available or fully implemented. Users on a network may see significant improvements in the time required to shut down, although our tests failed to show this.

In general, your system should perform about the same running Windows 98 as it did running Windows 95. But if you convert to FAT32, you will gain some disk space and see subtle but important changes in application load time. These subtleties represent some of the greatest benefits to upgrading to Windows 98.—*Larry Seltzer*

Hardware Support

Installing hardware should be faster and easier than ever under Windows 98, because of its extensive support for USB and IEEE 1394 (FireWire) devices. Universal Serial Bus (USB) is a hardware specification that lets you attach multiple peripherals to your PC without worrying about adding new adapter cards, finding available interrupts, or even taking the case off. IEEE 1394 is similar, but it's designed for devices that need more bandwidth, such as digital video cameras, digital video recorders, and storage devices. Our testing revealed that Windows 98 does make it easier to connect these devices, although currently there are not a great many of them out there. More USB devices are expected now that Windows 98 is here, with its strong native support.

USB devices include such peripherals as mice, scanners, and keyboards. Perhaps the most intriguing aspect of this technology is the number of devices you can use at once. You should be able to attach as many as 127 devices (through a series of hubs) to a PC without worrying about IRQs.

Although USB and 1394 also work with Windows 95, its support is more limited than that of Windows 98. USB support was added to Windows 95 with OSR 2.1, which supports 7 USB controllers from 6 vendors, compared with Windows 98's native support for 55 different controllers from 41 vendors. You can see which controllers and which vendors have built-in support by going to the Add Hardware applet on the Control Panel and looking at the USB controller section.

USB TESTING

PC Labs tested 11 USB peripherals on a 300-MHz and a 400-MHz Pentium II PC, under both Windows 95 with OSR 2.1 and Windows 98. As advertised, Windows 98 worked with all the devices and even auto-detected most of the peripherals.

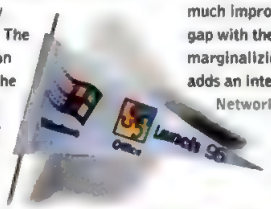
With many of the devices that we tested, though, we still needed a driver disk from the manufacturer—even under Windows 98. Think of it as similar to parallel and serial ports: Although Windows 98 provides drivers for many USB and 1394 devices, you may still need a driver from the vendor for your particular scanner, for example.

You may have to experiment with installing USB devices differently than the way the manufacturer instructs. With both the scanner and a fingerprint security device we tested, the vendor said to install the software first and wait until the PC prompted us to plug in the device. When we did that in both cases, we had difficulties installing. But when we started by plugging in the device first, Windows 98 took over, found the correct device driver, and loaded it. We then installed the appli-

large part to its popularity with the Linux crowd.

August 24, 1995
After numerous delays and unprecedented prelaunch hype for a software product, Windows 95

ships. In the frenzy, some people line up to buy it even though they don't own a computer. The first Windows version that didn't require the user to install DOS first, Win 95 is the most user-friendly Windows yet and



helps spur the mainstreaming of PCs. A much improved interface finally closes the gap with the Mac platform, ultimately marginalizing the Mac further. Win 95 also adds an integrated TCP/IP stack, Dial-Up Networking, and long filename support.

July 31, 1996
Microsoft ships Windows NT 4.0. A much-improved version from 3.51, it features the Windows 95 user interface, expanded device support, and numerous bundled server processes, like its Internet Information Server Web server. NT 4.0 firmly plants Microsoft in the enterprise space. Positioned as a Unix replacement, its presence in corporate America starts small but grows dramatically, and it increasingly becomes the platform

Editorial contributors: Emily Cohen, **Ben Z. Gottesman, David Lidsky, Michael J. Miller, Jay Munro, Larry Seltzer, Gail Shaffer, Nancy Sirapyan.**

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cation software and used the devices. These kinds of anomalies should be resolved soon, now that Windows 98 is available and vendors can test their products with it and update their documentation.

We got mixed results with our Windows 95 tests. Microsoft Natural Keyboard Elite was one of a few products that didn't come with a Windows 95 driver.

Windows 98 lets you connect nine monitors to a PC, giving you the power to create dramatic presentations.

1394 TESTING

Not many 1394 peripherals are available on the market today, but we did track down a Kodak DCS 520 digital still camera and a Canon Optura digital video camera. The Canon Optura worked well using the company-supplied drivers. The drivers supplied by Canon were for Windows 95, but we were able to use them with Windows 98 with good results.

Though USB devices should blossom now that Windows 98 has built-in support, 1394 devices may still only trickle into the market. Intel recently announced that it will not include 1394 support in any chip set through 1999, which will delay acceptance and product availability.

MULTIPLE MONITOR SUPPORT

Windows 98 also provides support for multiple monitors, a long-time Macintosh feature favored by graphic artists, programmers, CAD designers, financial traders, and other professionals. Many of them may very well stick with more robust Unix or Windows NT environments, but Windows 98 delivers the feature.

Windows 98 makes multiple monitor setup fairly easy and lets you connect as many as nine monitors to a single PC. To connect two monitors, you need a PCI graphics adapter with a supported chip set such as the ATI 64 GX, the S3 765, or the Cirrus 5436. To use several monitors at once, you must use a special video adapter, such as the STB MPV, which provides up to four VGA connections per card.

Built-in USB support in Windows 98 should inspire the production of a broad selection of available devices. IEEE 1394 and multiple-monitor support have less mass appeal but are long-awaited and welcome additions. As new devices emerge, Windows 98 will likely become a more attractive upgrade.—*Steve Rigney*

Laptops

Battery life is critical to road warriors who do the bulk of their work on notebooks. Microsoft recognizes this and has attempted to address battery life in Windows 98, although at present, you'll only be no worse off than before. Our tests showed no difference in battery life between Windows 95 and Windows 98 for the current generation of notebooks, but the new OS does provide access to a power-management applet that lets the user access power-saving features via a standardized interface. The OS also has built-in support for the Advanced Configuration and Power Interface (ACPI) specification. We couldn't test whether ACPI improved battery life since there is no notebook properly configured to support ACPI today.

Windows 98 also supports the latest revision of the Advanced Power Management (APM) specification, APM 1.2. One improvement in APM 1.2 is that it can determine whether standby mode is supported by your BIOS without trying it first, which prevents crashes.

You also have more detailed options for managing power than in Windows 95, where you basically had no specific control and had to rely on the vendor's proprietary power management application. Now you can turn off the hard disk and screen when they are not in use, and you can choose when your system goes into standby with a detailed set of time and usage options.

BATTERY TESTS

On our tests, we found that battery life neither increased nor decreased significantly on four notebooks: a Dell Inspiron 3000 M233XT, an IBM ThinkPad 380XD, a Gateway Solo 5100, and an HP OmniBook 2100, using APM.

We ran the ZD BatteryMark 2.0 test, which is designed to emulate an active user—one who does not let the system go into standby mode but is actively working in applications such as those included in Winstone 98 (word processing, spreadsheets, and so on). BatteryMark includes disk, CPU, and graphics activity modeled on Winstone and inserts "think times" to further simulate user interaction and permit disk spin-downs and CPU throttling.

ACPI

The next wave in power management for notebooks as well as for desktops and servers is ACPI, an API that gives more power management control to applications than APM. This is a big step toward

for intranets and public Internet sites.

October 1996
OEM Service Release 2 (OSR2) for Windows 95 is made available to manufacturers for preinstallation. Contains interim bug fixes as well as improvements to many of the built-in features and applets of Windows 95 in the control panel. Some of the "new" features in Windows 98 make their debut here, including FAT32, which allows more efficient use of hard disk space, and improved Dial-Up Networking. OSR2 also included Internet Explorer 3.0, the first viable Web browser from Microsoft.

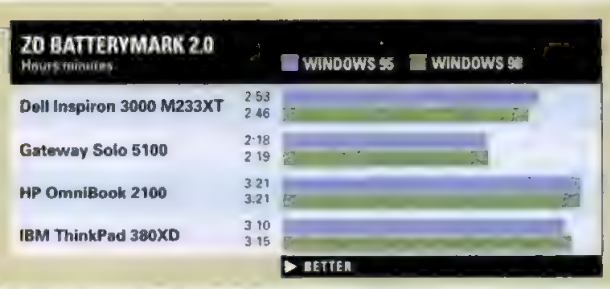
September 23, 1997
First beta of Windows NT 5.0 is given to a developer conference. The massive new version will support new generations of hardware, as well as improved management and security features. Expected release date: 1999.

June 25, 1998
Microsoft launches Windows 98, the last major version of Windows based on the old kernel running on top of DOS. Windows 98 integrates Internet Explorer 4 and supports numerous new device types, from USB to ACPI power management. Future consumer versions of Windows will be built on the NT kernel.

Graphics contributors: Paul Blattberg, Richard Graves, Doug Johnson, Joseph Longoria, Ryan Patterson, Larry Ritch, Susan Wiggins, and Microsoft Corp.

Battery Life Test

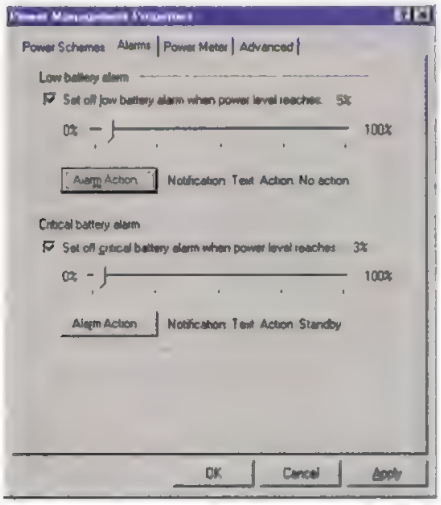
Our test showed that Win 98 offers no significant improvement in notebook battery performance.



having PCs that act much more like consumer devices such as TVs, which turn on and off and respond instantaneously.

In addition to powering external devices, ACPI lets you control power usage of internal system components (not just the motherboard), as with APM. For example, you could have your e-mail program set to download your mail every morning before you get up. With ACPI, the program would trigger the modem to wake up and turn off when it's finished.

But ACPI is dependent not just on OS support but also on hardware and applications support. The API that ACPI



Windows 98 can sound an alarm when battery power dips below a point you specify.

exposes lets developers build this vision. Whereas new Pentium II systems support ACPI, most systems will need a BIOS upgrade to enable it, as well as applications that support it. For example, ACPI-compliant PowerPoint would be able to tell your system never to go into standby when you're in slide-show mode (and in the middle of a presentation).

Now that Windows 98 supports ACPI, hardware vendors and applications developers have a reason to provide the necessary support. When ACPI finally replaces APM as the means of power management, it should reduce the power needed in a desktop environment and help increase the life of your notebook's battery—although only time will tell. Some notebook vendors, especially high-end vendors, suspect that battery life will diminish over the next year because of Microsoft's lack of experience in power management.

In general, with ACPI, notebook users running Windows 98 are no worse off than they were under Windows 95 and are a little better prepared for the future.—*SR*

System Diagnostics

Each new version of Windows comes with a new set of utilities that third-party packages can't match. Windows 98's new advanced diagnostic tools are so tightly integrated into the operating system that they can solve frustrating software conflicts and other system problems that other utilities can't even detect.

The new version also includes basic cleanup and efficiency-enhancing tools similar to those found in third-party packages. The new tools will definitely be a benefit to those who upgrade to Windows 98. But they're not necessarily so compelling that you need to upgrade because of them, unless you're a tinkerer.

The best of the third-party packages, such as Network Associates' Nuts & Bolts 98 and Symantec's Norton Utilities 3.0, won't be driven from the market by Windows 98, because they offer a variety of maintenance and convenience utilities that Windows doesn't offer at all. These utilities detect minor system problems that aren't solved by Windows' built-in tools, encrypt files, and provide real-time system monitoring and crash recovery. A third-party package remains an essential purchase for experts and beginners alike.

PC Magazine Labs compared Windows 98's diagnostic utilities with three third-party packages: CyberMedia's First Aid 98 Deluxe ($59.95 list), Network Associates' Nuts & Bolts 98 ($49.95 street, tested in a beta version) and Symantec Corp.'s Norton Utilities 3.0 ($79.95 list). Nuts & Bolts 98 is a new package designed for Windows 98; Norton Utilities and First Aid are still available in their Windows 95 versions, but by the time you read this, both should have minor upgrades available. If you're already a user, you can get these updates through Live Update and Oil Change, respectively.

BEGINNER-LEVEL MAINTENANCE

Windows 98's beginner-level maintenance tools comprise the Disk Defragmenter, ScanDisk, and Disk Cleanup—all of which are accessible from the Start Menu and can run automatically when you schedule them in the Maintenance Wizard. Each is less powerful and customizable than a third-party alternative. ScanDisk's disk checker adds a few customization options to the Windows 95 version but remains slow.

The Defragmenter uses Applog technology (licensed from Intel) to arrange files on disk so that applications load faster (see this story's Performance section for details), but Nuts & Bolts and Norton Utilities have added Applog technology to their Windows 98–compatible defragmenters. The defragmenters in the third-party tools also run faster than the Windows utility and have disk-organizing options not offered by Microsoft.

Disk Cleanup clears out temporary files, the browser cache, and the Recycle Bin, and provides access to an applet with which you can recover disk space by removing programs you don't need. It can't match the thoroughness of third-party uninstallers such as Quarterdeck's Clean Sweep or Norton UnInstall Deluxe, but it gets the job done quickly and easily.

HELP!

Windows 98's redesigned help system offers troubleshooting wizards that help you solve common hardware and software problems with a series of prompts. They can't solve complex problems that require the use of Windows 98 or third-party system-checking tools, but they're fast and

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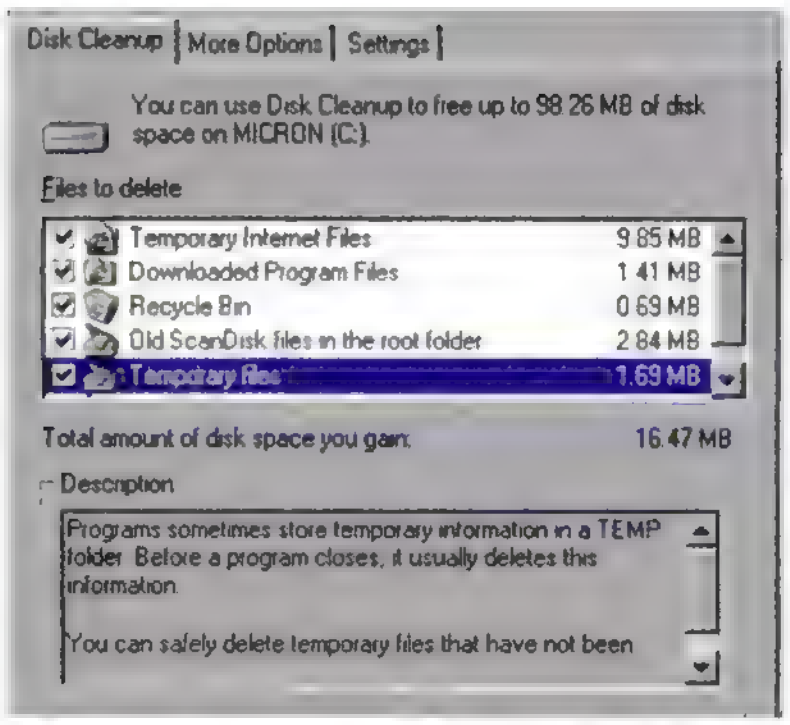


Disk Cleanup, a new utility, empties temp folders and your browser cache to recover disk space.

effective enough to deal with undetected modems, missing fonts, DOS programs that won't run, and other common issues.

ADVANCED DIAGNOSTICS

Windows' new advanced-level diagnostic and maintenance tools surpass anything available in third-party packages. The tools are normally accessible from the System Information program's Tools menu, but advanced users can run them directly from the Start/Run box using the filenames given below.

The system configuration tool Msconfig.exe lets you identify the source of your system problems by temporarily removing one or more start-up items from Config.sys, Autoexec.bat, Win.ini, System.ini, or the Windows registry. The closest equivalent is the EZ Setup program in Nuts & Bolts, which lets you remove items permanently from Windows start-up programs only and doesn't let you temporarily disable them, as Microsoft's utility does.

Microsoft's unique System File Checker (Sfc.exe) scans your system for files that have been overwritten with earlier or defective versions by installation programs from Microsoft and other vendors. The program prompts you to restore the correct version from the Windows 98 CD or lets you decide to keep the replaced version. It also tracks changes to third-party DLLs and other system files not installed by Windows itself. This program can save you from having to reinstall Windows or restore your whole system from backups when a problem is caused by only one file. Nothing like this is available in the third-party packages.

A similar utility, the Version Conflict Manager, keeps track of any newer versions of system files and other files that are overwritten when you install Windows 98. When upgrading, you can use it to access a record of the older file versions and restore them if you decide to. The function is designed to be accessible from the System Information Utility, but you can also access it by running Vcmui.exe.

The Automatic Skip Driver Agent enables Windows to start up without trying to load a driver that can't be found or refuses to load; then, after Windows twice fails to load the driver, the Agent automatically turns the driver off. You can run the Agent from the Run box (Asd.exe) or System Information Tool to see which drivers failed to load so that you can find a replacement from the driver's vendor. Again, no third-party package has anything like it.

The Registry Checker (Scanregw.exe) scans the Registry for serious errors that can prevent Windows from loading and makes backups that you can restore from a DOS prompt. By default, it stores five registry backups, but it can be set to store as many as 99. The program deals with serious problems only, not the minor annoyances detected by the registry checkers in Nuts & Bolts and First Aid. The third-party packages (unlike Windows 98's tools) can help fix "orphan" entries—items that point to files that don't exist or are not where the registry says they are—but these problems tend to be limited to one or two applications rather than a complete system.

The Dr. Watson system-reporting tool (Drwatson.exe) has been enhanced to record a huge amount of details on the system state when a program crashes or at any other time. The information it records can be sent to software vendors to help them solve whatever problem you're having. A Windows Reporting Tool (Winrep.exe) sends bug reports and Dr. Watson files directly to Microsoft. Once again, nothing matches these tools in any third-party package.

WINDOWS UPDATE

Windows 98 also takes a page out of the playbooks of third-party utilities with its Windows Update Web site. You can run a wizard that checks for new drivers and system files, and you can then download and install the ones you choose. Each of the third-party tools we tested can do this for its own company's products, and the standalone version of CyberMedia's Oil Change scans the Web, including Microsoft's site, for any new drivers or files you might need for your system. Windows Update is likely to eliminate the need for Microsoft to release Service Packs for users to download.

A FEW THIRD-PARTY EXCLUSIVES

All three third-party products we looked at include virus-checking software, a category not included in Windows 98 (but included in the Plus! 98 Pak; see After Hours in this issue for more information). Norton Utilities only scans for viruses and doesn't include the virus-removal features of the other two packages.

All three also include memory-resident crash-protection programs—something not found in Windows 98. And both Nuts & Bolts and Norton Utilities have undelete programs. Nuts & Bolts' entry stands out for its powerful encryption, file-shredding programs, and the range and flexibility of its other modules.

Your system can run with the utilities in Windows 98 alone, but a third-party package designed for Windows 98 will make it run even more smoothly.—*EM*

Multimedia

The multimedia enhancements in Windows 98 are not much to get excited about—yet. The more interesting developments in multimedia on the Windows platform are still

to come, so this area doesn't offer a compelling reason to upgrade immediately.

WEBTV FOR WINDOWS

The most significant multimedia-related addition to Windows 98 is WebTV for Windows, which enables your PC's monitor to act like a television screen. But right now, the lack of enhanced programming damps the promise of TV-PC integration. If you want to watch TV on your PC while you do other things, then WebTV has some value, but for now, you'll get the same level of integration by putting a TV in your computer room.

You need a TV tuner adapter in your PC to use WebTV. We tested using ATI Technologies' ATI All-in-Wonder, the only product shipping with the proper drivers at launch. WebTV has a wizard-based installation that scans for channels on your antennae-based or cable TV system, or can load program data from a remote Web site. This information then appears in the Programming Guide, an application that looks like the Prevue Channel on your cable TV. This represents the sole WebTV application at present.

The Programming Guide can accept Web-based digital data broadcast over the vertical blanking interval (VBI)—an unused component of a standard TV broadcast signal. But during our testing period, we could find no stations broadcasting such enhanced content.

WAVETOP

Windows 98 also bundles WavePhore's WaveTop Internet content push service. WaveTop is an advertising-supported service that downloads its content over the VBI, using signals from PBS stations around the country. It stores the data to disk for instantaneous viewing. WaveTop also requires you to have a TV tuner card in your PC, but you get a lot of premium Web content without needing a live Internet connection.

Note, however, that WaveTop can run on Windows 95 with the proper drivers, so you don't need Windows 98 to run it. Even though WaveTop uses the VBI to send its data and WebTV can accept digital data delivered over the VBI, WebTV's guide doesn't recognize WaveTop as a channel. The lack of integration between the two services diminishes their usefulness.

WebTV's Programming Guide helps you find what's on TV and can launch WebTV for Windows.

KERNEL STREAMING

A behind-the-scenes addition to Windows 98 is the kernel-streaming architecture, which streamlines large data transfers. Unfortunately, devices that will take advantage of this architecture aren't yet available. Look for multimedia creation and playback devices to be the first to do so.

The remainder of Windows 98's multimedia enhancements—the bundling of the new DirectX 5.1 architecture and its client, DirectShow, and DVD support—are available with Windows 95 and the appropriate drivers. Once kernel-streaming applications develop, broadcasters deliver ancillary Web content with their programming, and Chrome, Microsoft's new platform for better-quality multimedia for higher-end PCs, becomes a reality sometime next year, Windows 98 may represent a more notable multimedia platform than Windows 95. But that's not the case today.—*Jan Ozer*

Networking

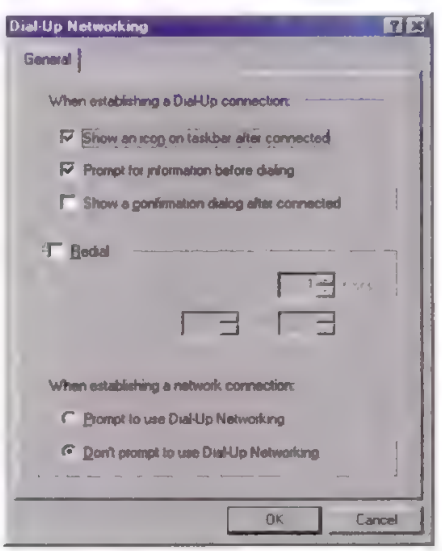
As networking becomes more integrated with computing, some new features and support for networking standards found in Windows 98 will become more useful. Many of the improvements are in service-release versions of Windows 95, while some other additions are client support for network products that aren't available at the desktop yet, such as asynchronous transfer mode (ATM) and Windows Quality of Service (QoS).

If you primarily use TCP/IP on your LAN, or if you use Dial-Up Networking to connect from a remote location, then Windows 98 is worth the upgrade. If you have Windows 95 OSR2, however, you might want to wait.

DIAL-UP NETWORKING

The most useful networking feature in Windows 98 is the improved Dial-Up Networking, first released in Windows 95 OSR2. The time-saving feature includes the ability to bypass the log-on screen before you make a call; it also offers a redial option that enables your modem to keep trying a busy number until it makes a connection. The Dial-Up Networking address book has also been improved in Windows 98 to add room for ten-digit telephone numbers and credit card calls.

Dial-Up scripting was previously available only in the Win95 Plus! Pak, but now it is included as a menu option in the Windows 98 Dial-Up Networking utility. Another Plus! utility now included with Windows 98 is the Dial-Up server.



The improved Dial-Up Networking applet in Windows 98 makes getting online easier.

Unlike the Remote Access Server (RAS) that comes with Windows NT 4.0, the Dial-Up server in Windows 98 is limited to a single connection.

NEW TCP/IP STACK

The most arcane (but important) improvement in Windows 98 is the new TCP/IP protocol stack. Microsoft's older TCP/IP stack contained NetBIOS information that made it larger, slower, and sometimes incompatible with other systems. This new native TCP/IP stack is smaller and designed to interoperate better with different TCP/IP stacks from third-party vendors.

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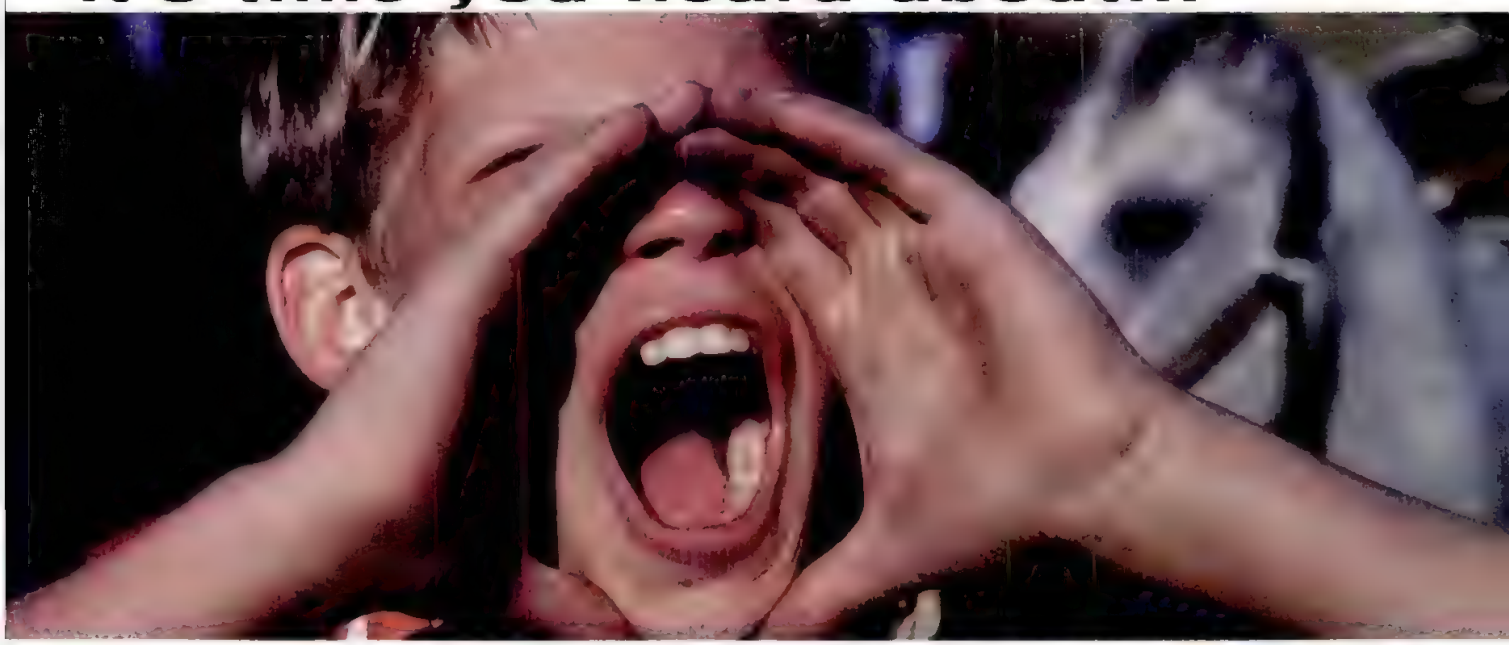

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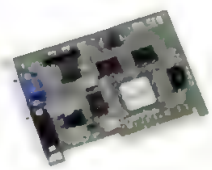

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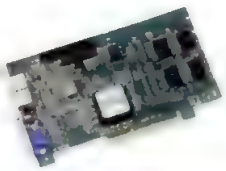

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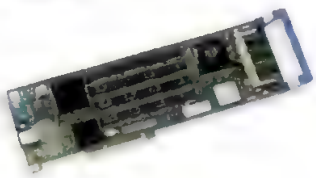

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TCP/IP is also now the default protocol when you install networking in Windows 98, upgraded from optional status under Windows 95.

NETWARE SUPPORT

In our testing, we found the Windows 98 support for the NetWare Directory Services (NDS) somewhat lacking. Although a client appeared to log into our NDS tree, we were not able to perform administrative tasks such as running NetWare Administrator and other NetWare utilities. When we issued a command to identify the Windows 98 user, the client still registered as an older Bindery user and not as a true member of the NDS tree.

MULTILINK CHANNEL AGGREGATION

Multilink Channel Aggregation, which lets you increase your dial-up bandwidth, remains a somewhat difficult process, because this feature requires two analog phone lines or a digital ISDN circuit. On our tests, we were able to connect two analog modems to the same PC and dial into a single server running Windows NT RAS. The bandwidth from the two 33.6-Kbps modems merged—or *aggregated*—and provided us with about a 64-Kbps connection for downloading files. You can take advantage of this feature on your Windows 95 desktop if you have OSR2.

VIRTUAL PRIVATE NETWORKING

Windows 98 uses the Point-to-Point Tunneling Protocol (PPTP) to let you establish a Virtual Private Network (VPN) across the Internet or a corporate intranet. Essentially, PPTP tunnels additional network protocols inside TCP/IP to perform this function. For example, on our tests we used TCP/IP to connect to our NT server and then used the tunneled IPX protocol to see our NetWare servers on the remote network. This tunneling will also work over the IP-only Internet, giving companies more secure extranet capabilities without requiring a dedicated dial-up link.

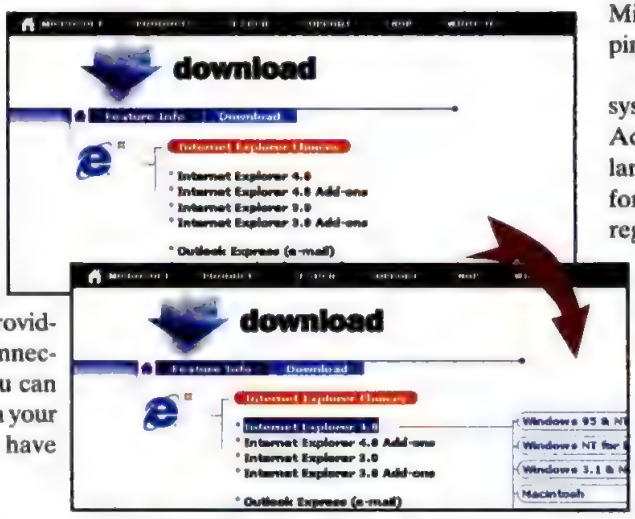
Windows 98 provides strong client-side support for networking. Most of the enhancements it offers are available today in Windows 95 OSR2, but Windows 98 also includes support for on-the-horizon networking enhancements. If you're worried only about today, later versions of Windows 95 should serve most of your networking needs for now.—*SR*

Development

Major operating system releases (like Windows 95) include significant new facilities for programmers, such as new APIs. The relative absence of these in Windows 98 underscores the fact that this is a Windows 95 upgrade and not a new operating system. Windows 98 does, however, include a few new ways to write programs—some of them quite useful.

IE4 AND DYNAMIC HTML

One of those techniques employs Internet Explorer 4.0, which is a platform for powerful programs written in Dynamic HTML. Windows 98 will increase the prevalence of IE4, thereby increasing the use of DHTML and giving developers another reason to take advantage of what it offers.



Dynamic HTML lets you make changes on Web pages without calling the server again.

Dynamic HTML is an emerging standard that combines HTML, scripting, and an object model for the browser and its contents. Programmers can use this new standard to manipulate a Web page in ways that previously were impossible. IE4 provides superior layout precision through its support of Cascading Style Sheets and certain associated standards. Lastly, IE4 supports scriptlets, which let programmers create reusable chunks of browser code.

A clear example of the power of IE4's advanced HTML is Windows 98's new Help system, which is based entirely on HTML and scripting in a particular format. This feature represents a new development opportunity, because Win 98's new Help facility enables the use of Java, streaming video, Macromedia's Shockwave, and more—all of which makes the Help system more interactive and demonstrative. In addition to this, Help can include links to vendor sites, where updated information and software patches may be found.

WINDOWS SCRIPTING HOST

The last major new way for programmers and end-users to write programs in Windows 98 is via the Windows Scripting Host (WSH). This feature takes the same Active Scripting engine in Internet Explorer and plugs it into the Windows shell, creating the first Windows batch language from Microsoft (third parties have been shipping such products for years).

Because WSH has access to numerous system and network facilities by means of ActiveX controls, it will become a popular way to write system maintenance code for such things as network drives and the registry. For example, a network administrator could call a WSH script from users' log-on scripts, use it to test whether certain programs were installed or configured correctly, and then report the results back to the administrator.

Because some time will pass before these capabilities are present on most systems, developers will have to wait until they can make widespread use of them. But these features are going to be useful enough that programmers should get to know them now.—*LS* PC

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Windows 98 cheat sheet

30 tips and tricks to help you get the most out of your PC, whether you're running Windows 98 or even 95.

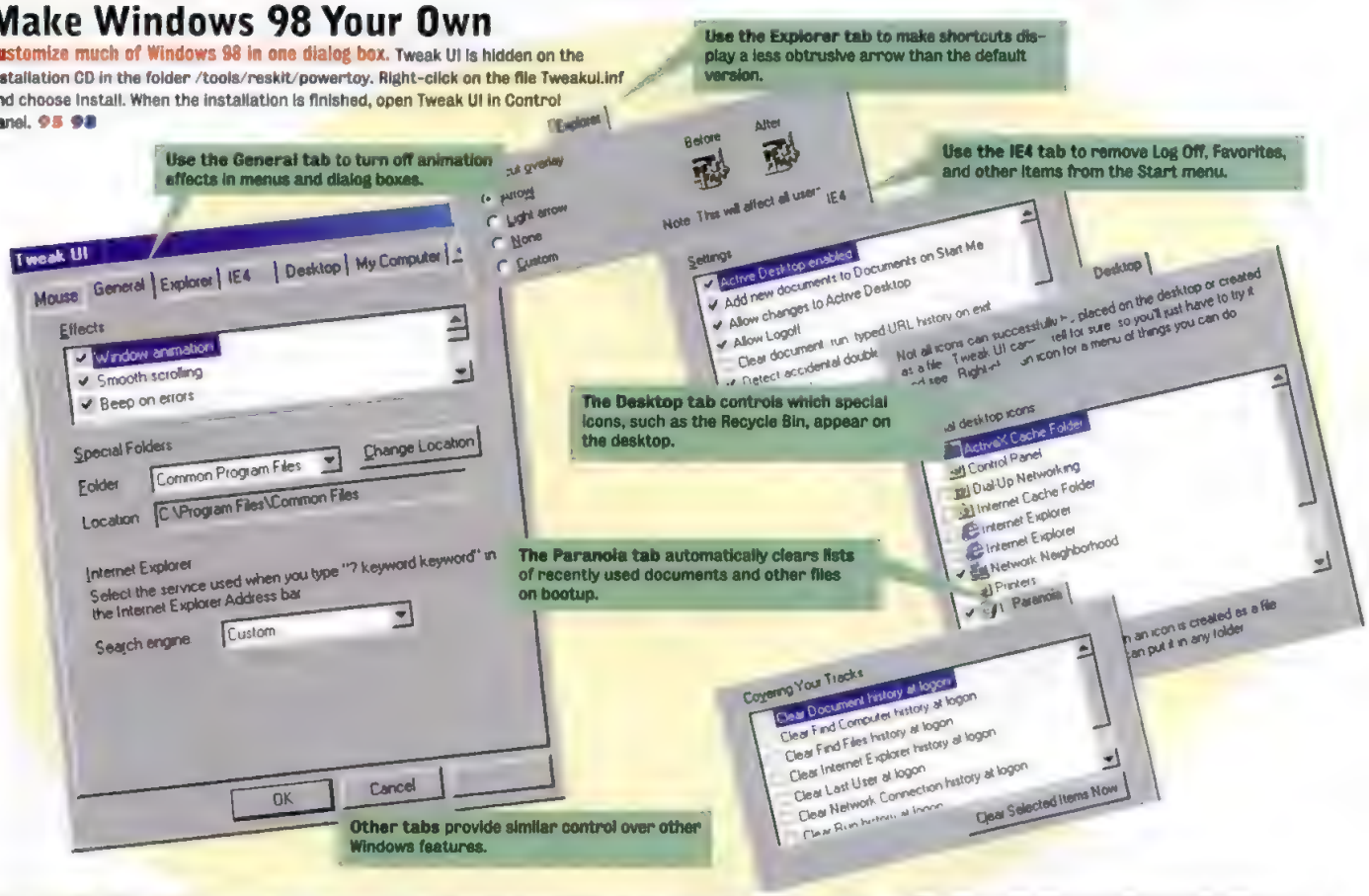
Getting Started

Do your homework before you upgrade. Check the home pages for the third-party software and hardware you are running to see if there are any conflicts with Windows 98.

Get the most current version of system utilities before upgrading. If you're running a system utility such as Symantec's Norton Utilities or Network Associates' Nuts & Bolts, make sure it is the most current version before you upgrade to Windows 98. We expect new revisions of these tools to be released around the launch of Windows 98. You stand a better shot at compatibility with your new OS.

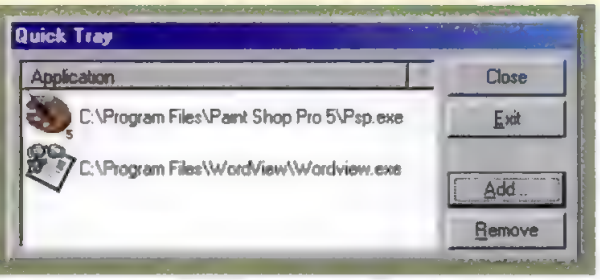
Make Windows 98 Your Own

Customize much of Windows 98 in one dialog box. Tweak UI is hidden on the installation CD in the folder /tools/reskit/powertoy. Right-click on the file Tweakui.inf and choose Install. When the installation is finished, open Tweak UI in Control Panel. 95 98



Add any program to your System Tray with Quick Tray

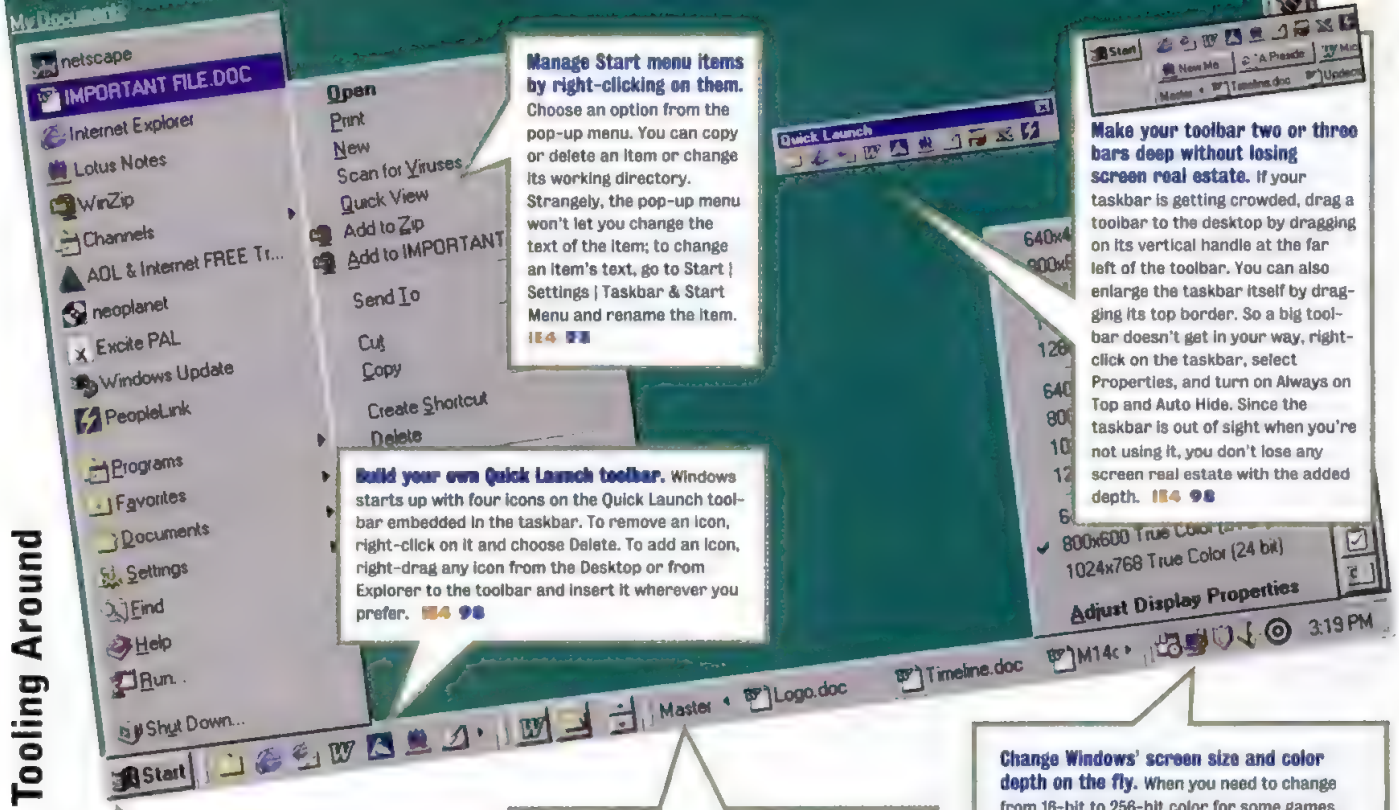
You'll find Quick Tray on the installation CD in the folder /tools/reskit/desktop. Of course, it sits in the System Tray, too. Windows 95 users can download Quick Tray and Tweak UI from Microsoft's Web page at www.microsoft.com/windows/downloads/default.asp. 95 98



Install Microsoft Fax and the Windows Messaging (formerly Microsoft Exchange) mail client. Neither is installed by default in Windows 98, and the fax software requires that Windows Messaging also be installed. On the installation CD, go to /tools/oldwin95/message/us. Click on Wms.exe to install Windows Messaging, then click on Awfax.exe to install the fax software. 98

Which OS do you need? 95 Windows 95 or better IE4 Windows 95 and IE4 or Windows 98 98 Windows 98 only

Contributors: Doug Beizer, Ben Gottesman, David Lidsky, Melanie Lopez, Edward Mendelson, Jay Munro, Jan Ozer, Keith Pleas, Steve Rigney, Neil Rubenking, Larry Seltzer, Barry Simon, M. David Stone.



Manage Start menu items by right-clicking on them. Choose an option from the pop-up menu. You can copy or delete an item or change its working directory. Strangely, the pop-up menu won't let you change the text of the item; to change an item's text, go to Start | Settings | Taskbar & Start Menu and rename the item. IE4 98

Make your toolbar two or three bars deep without losing screen real estate. If your taskbar is getting crowded, drag a toolbar to the desktop by dragging on its vertical handle at the far left of the toolbar. You can also enlarge the taskbar itself by dragging its top border. So a big toolbar doesn't get in your way, right-click on the taskbar, select Properties, and turn on Always on Top and Auto Hide. Since the taskbar is out of sight when you're not using it, you don't lose any screen real estate with the added depth. IE4 98

Build your own Quick Launch toolbar. Windows starts up with four icons on the Quick Launch toolbar embedded in the taskbar. To remove an icon, right-click on it and choose Delete. To add an icon, right-drag any icon from the Desktop or from Explorer to the toolbar and insert it wherever you prefer. IE4 98

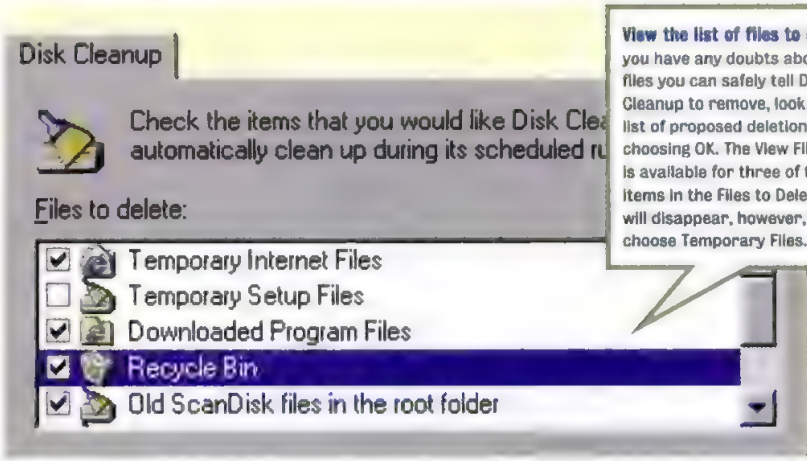
Customize the Start menu with drag-and-drop. Add a shortcut to the Start menu by dragging a filename or shortcut to the Start button. Wait for the menu to open, then drag to any position and drop—or drag to a submenu, wait for the submenu to open, then drag into the submenu and drop. You can also drag and drop items already in the Start menu. IE4 98

Create a toolbar containing icons and names of the files in any folder. Right-click on the taskbar, choose Toolbars | New Toolbar, and select any folder on your system. The name and icon of each file in the folder will appear on the resulting toolbar. If you right-click on the title of the toolbar, you can modify it to display icons only or to hide the title. IE4 98

Change Windows' screen size and color depth on the fly. When you need to change from 16-bit to 256-bit color for some games, you can add a Settings icon to the System Tray. Right-click on the Desktop and choose Properties from the pop-up menu. The Display Properties dialog will appear; in the Settings tab, choose Advanced and put a check mark next to "Show settings icon on the taskbar." To change your screen resolution, right-click on the icon and choose what you need. 95 98

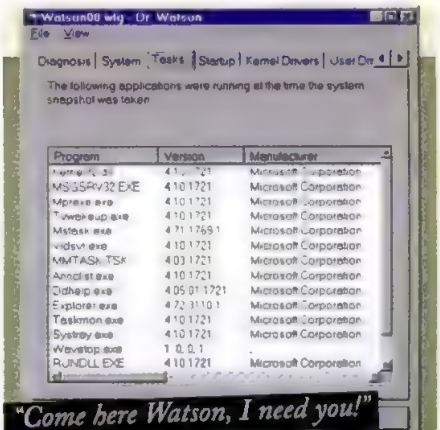
Check Under the Hood

Run the Maintenance Wizard occasionally to speed up your applications' launch times. Go to Start | Programs | Accessories | System Tools | Maintenance Wizard, then click "Perform maintenance now." Be aware that the maintenance process can take a few hours. To reduce the running time, customize the wizard to ignore drives that contain only data. From Maintenance Wizard, select Custom and then select the drives you want to optimize. 98



View the list of files to delete. If you have any doubts about which files you can safely tell Disk Cleanup to remove, look at the list of proposed deletions before choosing OK. The View Files button is available for three of the four items in the Files to Delete list. It will disappear, however, if you choose Temporary Files. 98

Optimize the Disk Cleanup utility. Change Disk Cleanup's option settings (available from the Maintenance Wizard) so that it cleans out the Recycle Bin and Temporary Files directory. After you change the settings by hand, the new settings will be used by the Maintenance Wizard when it cleans out files automatically on scheduled cleanups. 98

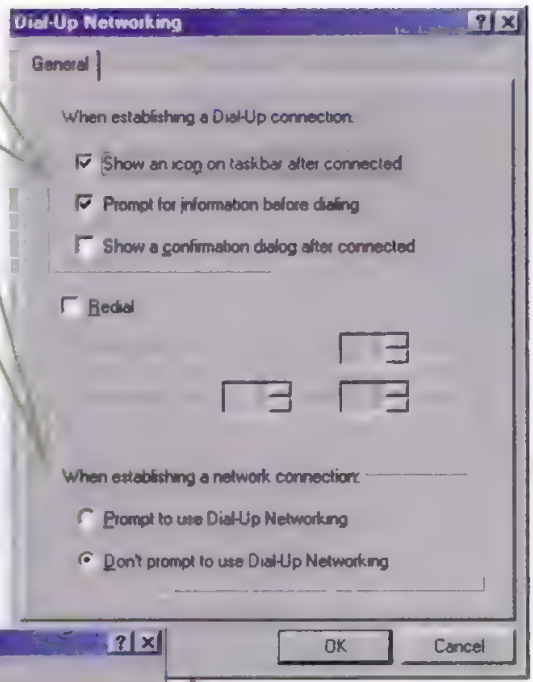


"Come here Watson, I need you!"

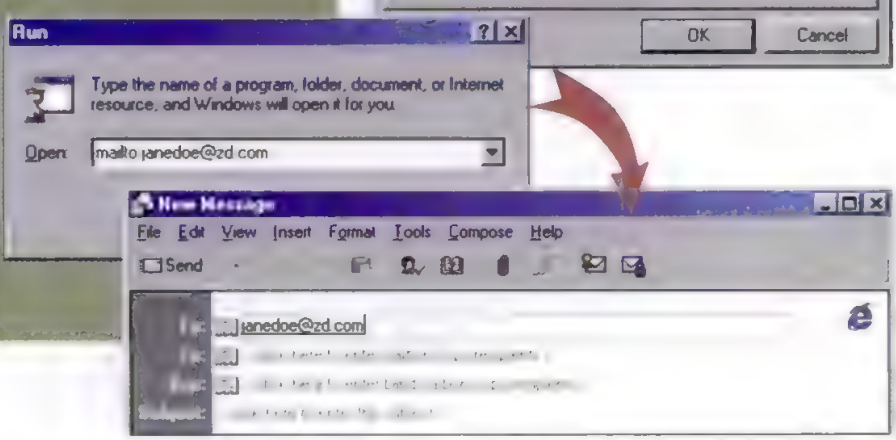
How to get the most out of the improved Dr. [illegible] The information saved by Windows 98 when there is a crash is vastly greater than before, as seen here in Dr. Watson's advanced view. But you need to run Dr. Watson before the crash (put it in your StartUp group) to have the information saved. 98

Integrate with the Web

Automate your Internet connections. Go to My Computer and open the Dial-Up Networking folder. Choose Connections | Settings, clear the check boxes labeled "Prompt for information before dialing" and "Show a confirmation dialog after connected," and select the radio button labeled "Don't prompt to use Dial-Up Networking." Make sure the check box labeled "Show an icon on taskbar after connected" is checked, so you can close an open connection by right-clicking on its icon in the system tray. IE4 98

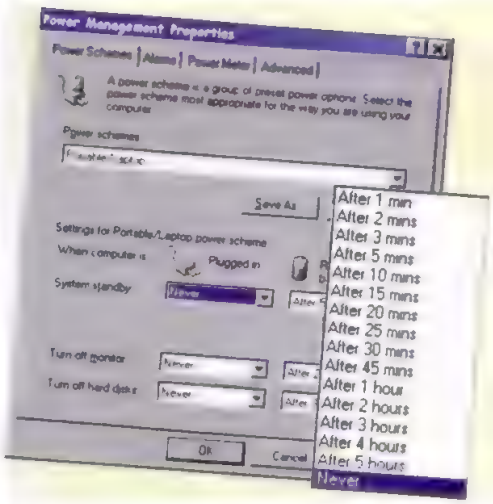


Go to Start | Run and enter (without the quotation marks): "mailto:name@address" (replacing name@address with a valid e-mail address). A New Message window will open with the address already filled in. 98



Add Dial-Up Networking connections to the Start menu. Open the Dial-Up Networking folder in My Computer. Right-drag a connection icon to the Start button, hovering over the button until the menu pops up. You can now drop a shortcut onto the main menu or hover over the Programs item and then over any submenu until you find the one where you want to create the shortcut. 95 98

And a Few More...



Keep your notebook from going into sleep mode when you don't want it to. Configure the Power Management settings, found in Control Panel, to go into sleep mode when your notebook is using batteries but to stay awake when it is connected to an AC outlet. The settings are under the Power Schemes tab. 95 98

Stop CDs from auto-playing. Assuming that you haven't otherwise disabled this feature in Tweak UI, just hold down the Shift key when inserting the disk. 95 98

Completely delete files from your system without the customary pit stop in the Recycle Bin. If you normally send deleted files to the Recycle Bin but want to delete a file completely from your system, just hold down the Shift key while you're deleting the file (this also works from the File | Open and File | Save As dialogs). 95 98

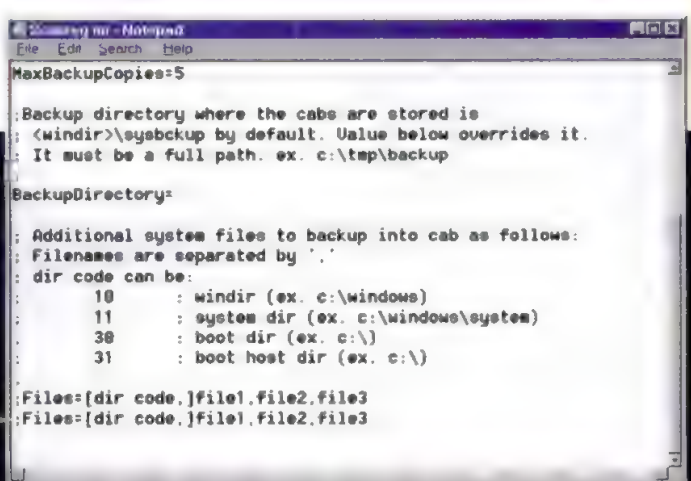
Access WebTV for Windows. WebTV can be activated from a small icon on the System Tray. To run it, you'll need a TV tuner card, available starting at around $110. 98

For Advanced Users Only

Use the Windows Scripting Host to run simple scripts. Run a script like the following, which sets the machine's time to that of a particular time-server computer on your network (you will want to turn on the "Close on exit" option for command windows):

```
Set WshShell =
WScript.CreateObject("WScript.Shell")
WshShell.Run "net time \\machine /set /yes" 98
```

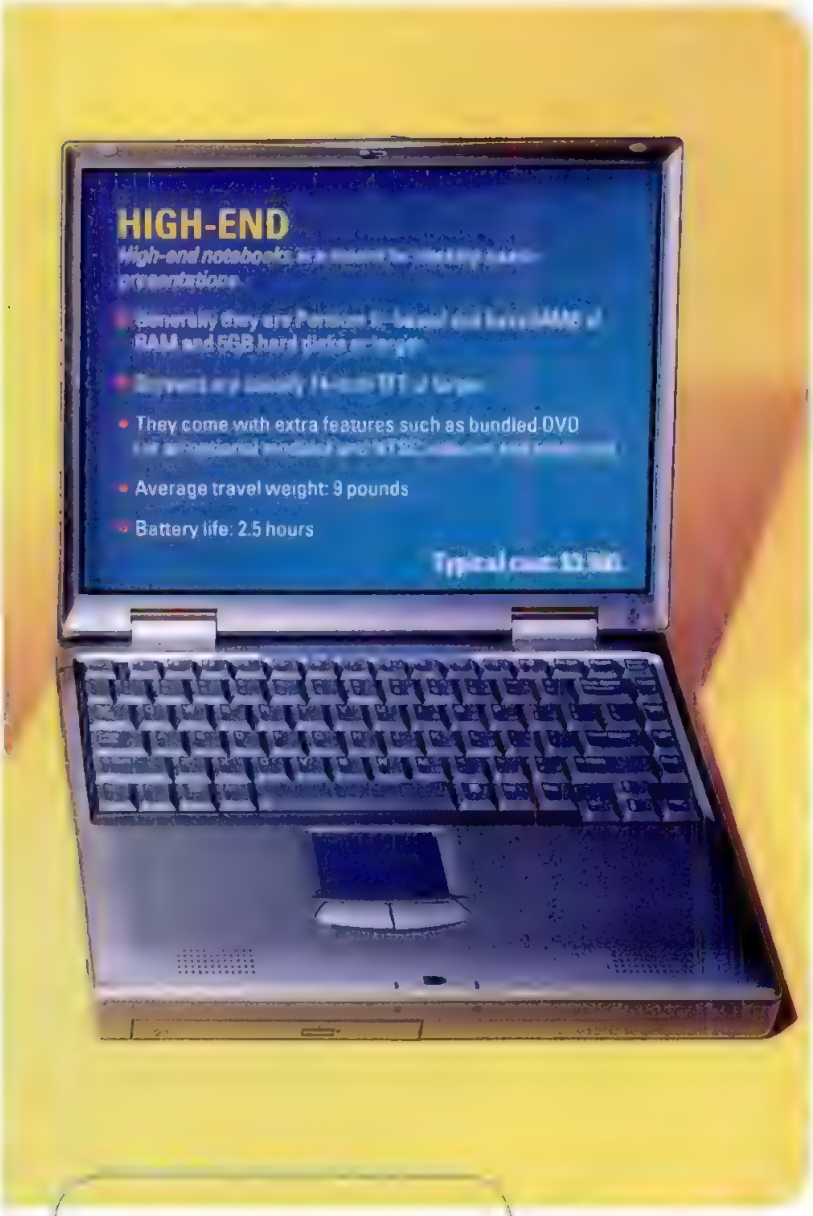
Add your own files to system file backups. Windows automatically saves backups of basic system files (System.dat, User.dat, Win.ini, System.ini). You can have the system back up additional files by editing C:/windows/scanreg.ini. Directions are in that file as comments. 98



NOTEBOOKS

Traveling POW

PC Labs tests 54 notebooks divided into 26 high-end desktop replacements, 24 mainstream value systems, and 4 lightweight subnotebooks. By Bill Howard



Cheaper and more powerful. A familiar refrain to desktop users, especially this past year; now the trend has made its way to notebooks. Notebooks still cost more than desktops, but they're rapidly coming down in price and closing the performance gap, offering Pentium II CPUs, hard disks up to 8GB, and displays up to 15 inches. And the good news is that you don't have to sacrifice battery life to get that power.

In our last notebook roundup just six months ago, Pentium MMX systems ruled the high-end of the market; some of the best systems still cost a whopping $7,000. Not anymore. Pentium IIs set the performance bar; you'll find them even in value-class systems ($2,000 to $3,000) along with 13.3-inch active-matrix screens, although the majority still have 12.1-inch panels. The very top of the line, as seen among major notebook vendors, has also come down in price, hovering around $5,000. With falling prices and increasing power, laptops will grab an ever bigger part of the PC market: At 15 percent of sales a year or two ago, they should reach 22 percent by 2002, according to ZD Market Intelligence (formerly Computer Intelligence).

www.pcmag.com

Join us online for an examination of the heat distribution of these 54 notebooks. Check "Coping with the Heat" for a preview.

enhouses

REVIEW CRITERIA

We asked vendors to send previously unreviewed systems, classified per three categories (high-end, value, and subnotebook), that were available as of mid-spring and that would still be on the market as of the beginning of July. We also requested the current version of a previous Editors' Choice, the IBM ThinkPad 560X.

The lines dividing the categories are fuzzy. You can't use hard-and-fast rules about price, performance, or size to separate them. Some of the value and subnotebooks came with Pentium II CPUs. High-end notebooks are cheaper than they were. In the past, a subnotebook had only an internal disk; now some have a modular bay that accepts a CD or DVD drive. Bearing that in mind, here's what we required.

High-end notebooks (also called presentation or desktop replacement systems): Pentium II processor preferred, 13-inch or larger active-matrix display with 1,024-by-768 (XGA) resolution, exactly 64MB of RAM, 4GB hard disk (minimum), a DVD or 20X CD-ROM drive, 2MB of video RAM (4MB preferred), and wavetable sound.

Value notebooks (also called low-end or mainstream): Any processor, exactly 32MB of RAM, 12.1-inch (minimum) LCD with 800-by-600 (SVGA) resolution, 2MB of video RAM, a CD-ROM drive, and audio capability. These systems typically sell for $2,000 to $3,000 and constitute the majority of the market. We didn't set a price ceiling, to see how different vendors defined affordable in their scheme of things.

Subnotebooks (also called lightweights): 5 pounds maximum system weight without removable drives (a 5.4 pound system including a removable 0.7 pound floppy disk drive would qualify), any processor, exactly 32MB of RAM, and an 11-inch LCD with SVGA resolution.

We received 54 systems in all: 26 classified as high-end notebooks, 24 as value notebooks, and 4 as subnotebooks. Twenty-one systems came with Pentium II CPUs (all but one at 266 MHz), 30 came with Pentium MMX processors ranging from 200 MHz to 266 MHz, and 3 came with AMD K6 processors at 233 MHz and 266 MHz. None used Cyrix CPUs; the two current Cyrix CPU offerings either draw too much battery power or don't have enough CPU horsepower to be competitive.

AST Research, CTX Computer, and Fujitsu PC Corp. were unable to get systems to us in time for this roundup. Umax Technologies, which has recently released the ActionBook notebook line, was also too late to be included. Sony Electronics' newest systems are sold with Windows 98 only, and the operating system was not ready in time for our roundup.

Also absent from this story are the intriguing 3-pounders that are true Windows-compatible PCs (rather than Windows CE systems), either because we reviewed them previously or because the samples we saw weren't fully ready. Vendors include Hitachi, Toshiba, HP and Mitsubishi (with similar systems), and most recently, Panasonic. See Trends PCs in this issue for more about the Mitsubishi unit and Trends PCs in the July 1998 issue for Panasonic's offerings.

These units attempt to strike a balance between extreme portability and notebook functionality. They're usually Pentium or Pentium MMX–based systems, and they're worth a look if you don't mind compressed keys (about four-fifths of the usual 19-mm key pitch), smaller screens, smaller drives, and smaller batteries. Sony is introducing the VAIO 505 (previously sold only in Japan), which also fits into this category.

PENTIUM II VS. MMX

With the introduction in April of the mobile version of the Pentium II processor—code-named Mobile Deschutes—Intel took great strides toward closing the gap between desktop and notebook performance. The desktop Pentium II still offers faster clock speeds, currently up to 400 MHz. It's likely that notebook Pentium IIs will reach 300 MHz later this year, but we won't see Pentium IIs hitting 350 (maybe 400) MHz until well into 1999; by that time desktops will be at 500 MHz or beyond. (The Pentium MMX may make it to 300 MHz, but that's the end of the line.)

The mobile Pentium II, fabricated on a 0.25-micron process, is currently available in 233-MHz and 266-MHz parts packaged as mobile modules or minicartridges. The mobile Pentium II operates at 1.7 volts internally and 2V externally. Compare that with the less-complex Pentium MMX (the Tillamook chip), which also uses an 0.25-micron process but operates at 1.8V internally and 2.8V externally. Though the Pentium II and Pentium MMX both address system memory at 66 MHz, the Pentium II addresses L2 cache (fixed at 512K) at half

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the speed of the CPU (133 MHz for the 266-MHz Pentium II), and Pentium MMX addresses cache at 66 MHz. CPUmark$_{32}$ differences are pronounced: Mobile Pentium II CPUs generally score about 35 percent better than Pentium MMX CPUs.

What does that mean in real terms? As measured by our ZD Business Winstone 98 test suite, a Pentium II at 266 MHz is about 20 percent faster than a Pentium MMX at 266 MHz. We saw average scores of 19 for the Pentium II versus 16 for the average of all tested MMX systems. In other words, the difference is measurable in the lab but not that noticeable to users.

Although in past roundups we've seen battery life differences between Pentium II and Pentium MMX CPUs of the same clock speeds, this time around the average difference was negligible—about 3 minutes—on the ZD BatteryMark 2.0 test. This is a welcome surprise, especially since as of late winter, many were expecting a loss of 20 to 30 minutes going from the Pentium MMX to the Pentium II.

The three AMD K6 systems ran roughly on a par with Pentium MMX/266 and MMX/233 in terms of performance. AMD systems, however, lost about 40 minutes on battery life compared with Pentium MMX systems. This one you'll notice.

So which to choose? If you value battery life, look for a good implementation either of a Pentium II or a Pentium MMX. For power, pick Pentium II. Interestingly, some business buyers have indicated a preference for Pentium II so that they can standardize the company on a single CPU platform, even though there's no compatibility difference.

BELLS AND WHISTLES

What's available in portable computers today isn't very different from the state of the art in desktops a year ago. Notebook hard disk capacities have reached 8GB and should hit 12GB a year from now. Two notebooks—the MetroBook DT and the essentially similar Fosa AP 8800M—have 15-inch displays; 14 systems have 14-inch displays. You'll have to judge for yourself how big is too big. Virtually any notebook screen is too big when you're sitting in coach class and the person in front of you reclines the seat. We do believe that 1,024-by-768 resolution is a bit tough on the eyes on a 12-inch display, whereas it's relatively

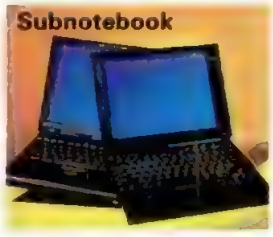
Editors' Choice

- High-end: Gateway Solo 9100LS, NEC Versa LX
- Value: Gateway Solo 2500SE
- Subnotebook: IBM ThinkPad 600, IBM ThinkPad 560X

Notebook categories are blurring, with high-end systems coming down in price and even more powerful value units. Subnotebooks, too, are packing ever more into lighter packages.

Our two high-end Editors' Choices are the Gateway Solo 9100LS ($3,849 direct) and the NEC's Versa LX ($4,300 street). Both have everything you need in a desktop replacement or presentation unit, beginning with a Pentium II/266, a 14.1-inch TFT screen, and a lithium ion battery; and both support three spindles.

The Gateway Solo 9100LS comes with a combination DVD/floppy disk module, a 4.8GB disk, and a 56K PC Card modem. Its DVD playback was one of the best we saw, and its performance was terrific. Gateway was also one of two laptop vendors this year to earn top scores on our reader survey of service and reliability. The unit's travel weight is a hefty 9.7 pounds, but battery life was 2:52.



The NEC Versa LX is ready for travel at 8.2 pounds; at 1.8 inches thick, it's fairly thin. The battery lasted 2:59 on our test, and the unit was a great performer. Other features include a 3.9GB hard disk, and an optional DVD module for $150.

For budget shoppers, the Gateway Solo 2500SE ($2,149 direct) is as close to a dream machine as we saw in this roundup. A good performer, the three-spindle unit comes with a Pentium II/233 and a 12.1-inch TFT screen; nothing is modular, however, and its disk is only 2GB. Its 5:01 battery life was one of the best in the roundup, and the travel weight is just 7.7 pounds.

Our two Editors' Choices in the subnotebook category expertly address the needs of specific types of road warriors. The IBM ThinkPad 600 ($4,600 street) packs a high-end punch into a 6.5-pound travel weight, including a Pentium II/266 CPU, a 13.3-inch TFT screen, and a 3.9GB hard disk. The unit can take a CD-ROM, DVD, or floppy disk drive internally—ideal for those who need supreme portability and don't want to deal with external drives. It lasted an impressive 3:12 on our test.

For the road warrior principally concerned with weight and battery life, there is still no better option than the IBM ThinkPad 560X ($3,100 street), a past Editors' Choice. The system came with a Pentium MMX/233, a 12.1-inch TFT panel, a 2GB disk, and a lithium ion battery that lasted a terrific 3:59 on our test. CD-ROM or floppy disk drive are external, but the system weighs just 4.1 pounds; ready for travel, it weighs 5 pounds.

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- ***3-D Graphics Accelerator w/4 MB SGRAM***
- *45 Watt Lithium Ion Smart Battery*
- *512k Pipeline Burst L2 cache*
- *3.5" Floppy Drive and 20X max variable speed CD-ROM,* ***both built-in, no need to swap***
- *Integrated dual-button* ***Touchpad and Pointing Stick****, both active simultaneously*
- *16-bit Stereo Audio*
- *Two Type II or one Type III PCMCIA slot, CardBus and ZoomedVideo supported*
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Price/Performance Index: Notebooks

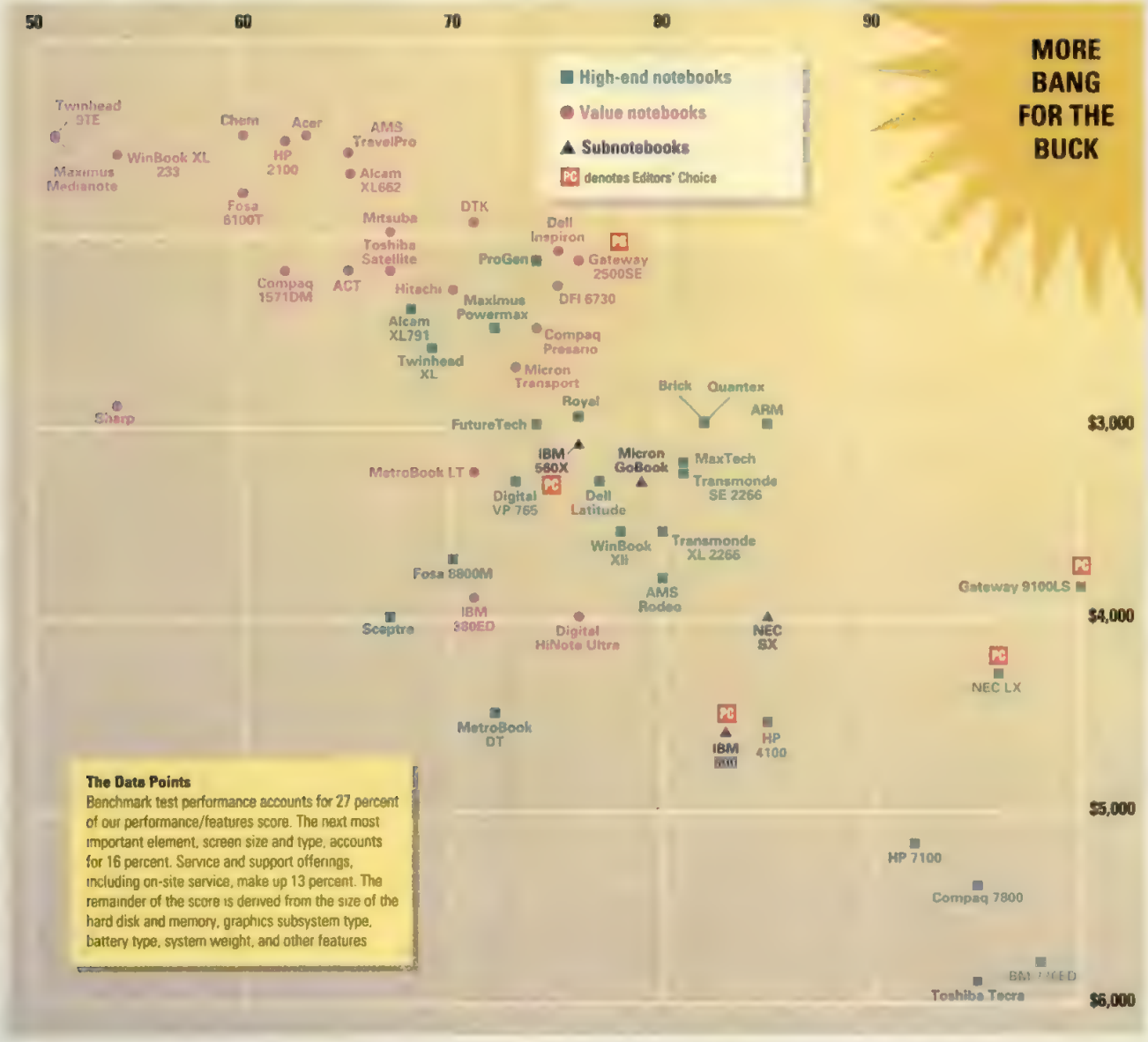
A front-runner on our Price/Performance index is one of the high-end Editors' Choice winners, the Gateway Solo 9100LS. For $3,849 you get good performance and the hot hardware power users crave: a beautiful 14.1-inch TFT screen, a Pentium II/266 CPU, and a 4.8GB hard disk. A desktop replacement rather than a road warrior, its travel weight is a hefty 9.7 pounds but its battery life was a respectable 2:52.

The other high-end Editors' Choice winner, the $4,300 NEC Versa LX, follows closely behind. Like the Gateway Solo 9100LS, it offers a 14.1-inch TFT screen and a Pentium II/266 CPU. Unlike the Gateway, it has an appealing travel weight of only 8.2 pounds; its disk is slightly smaller at 3.9GB but its battery life is just as good at 2:59.

Although the high-end Pentium II/266-based ARMNote TS759 is in a good position on our chart, there is a caveat: It could not run our BatteryMark 2.0 test possibly because of power management problems or an incompatibility with our test.

Two value-class systems stand out. The $2,149 Gateway Solo 2500SE, our Editors' Choice, packs three spindles, a 12.1-inch TFT screen, a Pentium II/233, and a 2GB hard disk in 7.7 pounds of travel weight—and it has an amazing 5:01 of battery life. The $2,200 DFI 6730 offers a Pentium MMX/200, a 13.1-inch TFT screen, and the same size hard disk. The 8.6-pound DFI lasted only 2:02 on our battery test.

—Analysis written by Mary E. Behr



The Data Points
Benchmark test performance accounts for 27 percent of our performance/features score. The next most important element, screen size and type, accounts for 16 percent. Service and support offerings, including on-site service, make up 13 percent. The remainder of the score is derived from the size of the hard disk and memory, graphics subsystem type, battery type, system weight, and other features

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By S. E. Easter

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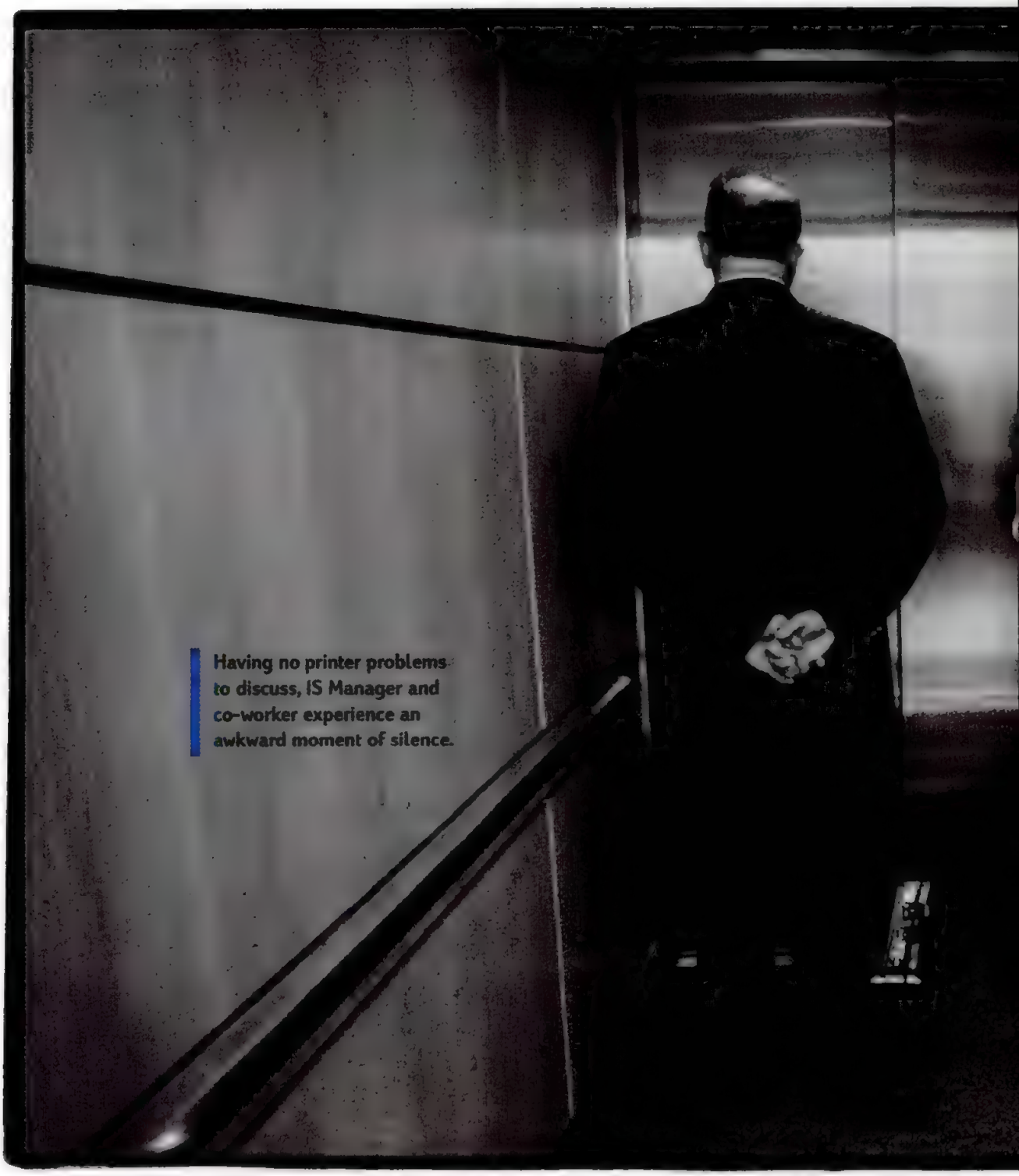

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comfortable at 13 inches and a delight at 14. A 14-inch LCD is equal to a 15.5-inch diagonal CRT display.

Graphics performance lags behind that of desktops. Only one vendor (Compaq) used AGP (Accelerated Graphics Port) graphics. Vendors have to put more thought into AGP engineering because it is more complex and can generate more heat. Expect more systems to take advantage of AGP later this year.

We've seen a resurgence of three-drive (also known as three-spindle) systems, which can accommodate a hard disk, floppy disk drive, and CD-ROM or DVD drive simultaneously—both in the high-end and value categories. Although a two-spindle system with a modular bay can be more flexible and is usually lighter, three spindles is far simpler, both for users and IS managers. You have fewer pieces to lose, forget, or damage, and it's far easier to keep track of inventory. With new technology, we've seen good three-spindle systems as light as 7.2 pounds (travel weight) and 6.5 pounds system weight.

BATTERY LIFE

The 54 systems we tested lasted anywhere from 1:12 (Maximus Powermax XGA CD Book and Mitsuba Dynasty 500) to 6:33 (Micron GoBook) on our BatteryMark test. The latter used a standard external battery that adds about 2.5 pounds to its weight; with both this and the internal battery, the GoBook lasted 8:29. Six units managed at least 4 hours, and the Gateway Solo 2500SE managed 5:01.

In PC Labs' battery performance tables, we report not just pure battery life but also battery efficiency, in hours of battery life per pound of battery. That's like reporting miles per gallon for cars. Some vendors get longer battery life by installing hulking batteries (a Cadillac with a 25-gallon tank goes a long way between refills but is not very efficient), others through intelligent design. The average unit had a 1.0-pound battery (the range was 0.7 pounds to 1.5 pounds), a 2:54 rundown time, and averaged 2:55 of runtime per pound of battery.

In terms of efficient power management, IBM was the hands-down winner, with battery efficiency ranging from 5:41 per pound for the ThinkPad 560X (3:12 actual rundown with a 0.7-pound battery) through 3:52 per pound for the ThinkPad 770ED (3:52 rundown with a 1.0-pound battery). Lest you think that only big vendors have done well, the rest of the battery-efficiency top ten includes Alcam (twice), Compaq, Hitachi, MetroBook, and Twinhead. And this underscores a key point: In terms of engineering savvy and build quality, the big names and the lesser names are a lot closer than they were two to three years ago. In fact, many of the major vendors subcontract their assemblies through the same vendors, primarily in Taiwan and sometimes in Korea. That also helps explain why the "Other" category has grown from a 29 to a 37 percent market share from 1995 to 1997, according to ZD Market Intelligence data.

If battery life is important to you, many vendors with modular bays let you swap in a second battery. To us, the best design makes the main and secondary batteries identical. Note also that bigger screen sizes don't automatically translate to inferior battery life. Resolution also plays a part; in general, systems with 1,024-by-768 displays had slightly shorter battery lives.

The bottom line: Notebooks are less expensive, are faster, and last longer on the road. You can get what you need, and you won't have to break the bank to do it.

Acer Extensa 367D

Pentium MMX/200, 12.1" DSTN, 2GB disk, 32MB SDRAM, 6.4 lbs. Battery: 3:12. Winstone 98: 12.8. $1,500 street. Acer America Corp., 800-733-2237, 408-432-6200; www.acer.com/aac. 501 at www.pcmag.com/infolink.

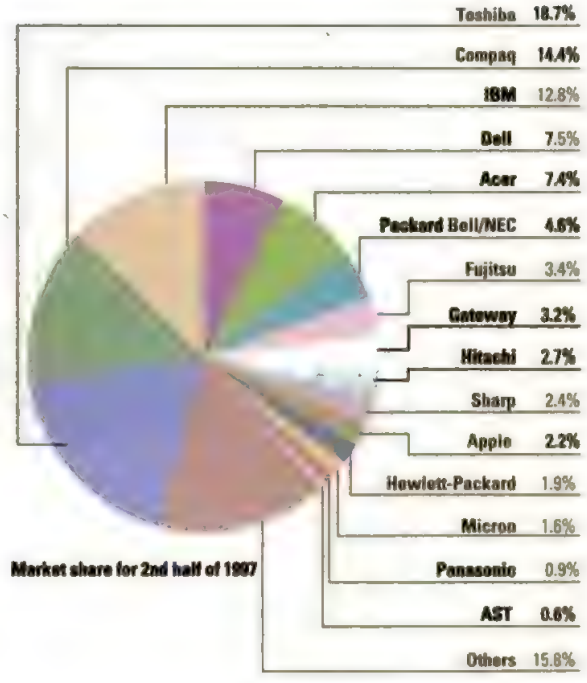
● Notebook users on a budget should take a look at Acer America Corp.'s Extensa models, which offer decent features and moderate performance at low prices. The Acer Extensa 367D, targeted for education, government, and small-

Top 15 U.S. Notebook Vendors

Below you'll find notebook unit shipments for both the first and second half of 1997, so you can compare how each vendor did over the course of the year.

Source: Dataquest, Quarterly Stats, February 1998.

	Unit shipments 1st half of 1997	Unit shipments 2nd half of 1997	Percent Change
Toshiba	613,500	608,612	▼ 1%
Compaq	309,834	467,459	▲ 51%
IBM	369,301	415,220	▲ 12%
Dell	151,695	243,060	▲ 60%
Acer	264,419	240,422	▼ 9%
Packard Bell/NEC	119,210	148,028	▲ 24%
Fujitsu	68,600	112,000	▲ 63%
Gateway	69,981	103,000	▲ 47%
Hitachi	86,434	88,565	▲ 2%
Sharp	80,590	77,190	▼ 4%
Apple	58,005	70,513	▲ 22%
Hewlett-Packard	44,902	61,419	▲ 37%
Micron	38,480	51,076	▲ 33%
Panasonic	29,787	29,275	▼ 2%
AST	18,450	19,483	▲ 5%
Others	407,354	511,962	▲ 26%



Notebooks

SUITABILITY TO TASK

	Road warrior	Desktop replacement
HIGH-END NOTEBOOKS		
Alcam XL791	Good	Good
AMS Rodeo 5032ECX	Fair	Good
ARMNote TS759	Poor	Fair
Brick Ergo BigScreen[4]	Fair	Good
Compaq Armada 7800	Fair	Good
Dell Latitude CPi D266XT	Good	Good
Digital HiNote VP 765	Fair	Good
Fosa AP 8800M	Poor	Good
FutureTech FutureMate 6300XL2	Fair	Good
Gateway Solo 9100LS	Fair	Excellent
HP OmniBook 7100	Good	Excellent
HP OmniBook 4100	Good	Good
IBM ThinkPad 770ED	Good	Excellent
Maximus Powermax XGA CD Book	Poor	Good
MaxTech YesBook X759	Fair	Good
MetroBook DT	Fair	Good
NEC Versa LX	Good	Excellent
ProGen Venture MMX266	Good	Good
Quantex H-1331 with PII266MHz	Fair	Good
Royal Mobile Pro II	Fair	Good
Sceptre SoundX 5500T	Fair	Good
Toshiba Tecra 780DVD	Good	Good
Transmonde Vivanté SE 2266	Good	Good
Transmonde Vivanté XL 2266	Good	Good
Twinhead Slimnote XL	Good	Good
WinBook XLi	Good	Good

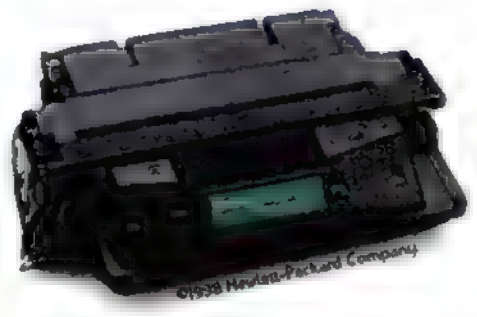
	Road warrior	Desktop replacement
VALUE NOTEBOOKS		
Acer Extensa 367D	Good	Good
Alcam XL662	Good	Good
ACT Innomation 5133LE	Good	Good
AMS TravelPro 2500CS	Fair	Good
ChemBook 3300	Fair	Fair
Compaq Presario 1640	Good	Fair
Compaq Armada 1571DM	Fair	Fair
Dell Inspiron 3000 M233XT	Good	Good
DFI 6730	Fair	Fair
Digital HiNote Ultra2000	Excellent	Good
DTK FortisPro Top5A233	Fair	Good
Fosa AP 6100T	Poor	Fair
Gateway Solo 2500SE	Good	Good
HP OmniBook 2100	Fair	Fair
Hitachi VisionBook Plus 5290	Good	Fair
IBM ThinkPad 380XD	Fair	Fair
Maximus Medianote CD Book	Poor	Fair
MetroBook LT	Good	Good
Micron TransPort Trek	Good	Good
Mitsuba Dynasty 500	Fair	Fair
Sharp PC-M200	Fair	Fair
Toshiba Satellite 335CDS	Good	Good
Twinhead Slimnote 9TE	Fair	Fair
WinBook XL 233	Fair	Fair
SUBNOTEBOOKS		
IBM ThinkPad 600	Excellent	Good
IBM ThinkPad 560X	Excellent	Fair
Micron GoBook	Good	Good
NEC Versa SX	Good	Good

Notebooks continue to encroach upon desktop territory. They also continue to travel the world. Above, we rate how well the notebooks in this roundup fulfill these functions. Product price is not a factor. Possible system ratings are excellent, good, fair, and poor.

The **road warrior** rating reflects the notebook's aptitude for road work. Key factors include battery life, travel weight, system size, screen type and size, and communications features such as integrated modems or PC Card slots

For **desktop replacement**, we consider the unit's ability to substitute for a desktop PC. A large screen with high resolution, multimedia features (especially a DVD drive), good performance, a large hard disk, full-size keys, and other such factors contribute to an excellent score

What good is a hassle-free printer if your toner isn't?



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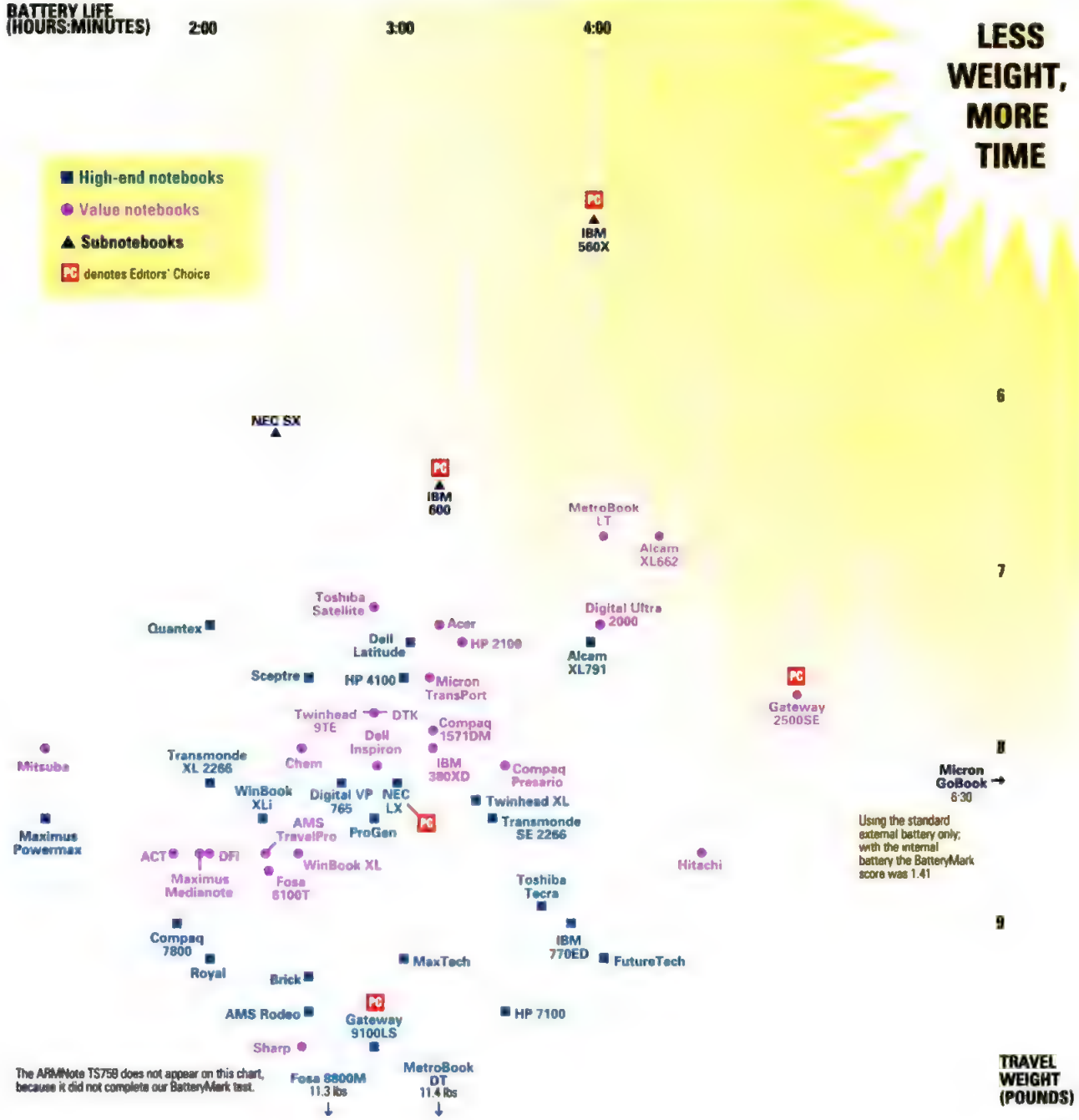
IMATION

Battery Life vs. Portability

This roundup of 54 notebooks covers a great spread: The units have both DSTN and TFT screens ranging in diagonal size from 12.1 inches to 15.1 inches and either lithium ion or nickel hydride batteries. Taking into account all three of the reviewed notebook categories (high-end, value, and subnotebook), battery lives spanned from 6:33 to 1:12. The ZD BatteryMark 2.0 test simulates real users' computing habits, down to the lulls in typing when users "think."

The $2,149 value-class Gateway Solo 2500SE, one of our Editors' Choices, is among the leaders in this roundup, with a lithium ion battery life of 5:01. Gateway has a history of making systems with a good battery life, and this one is no exception. This three-spindle system has a Pentium II/233 and a 12.1-inch TFT screen, and a 7.7-pound travel



weight, which includes system, battery, internal drives, AC adapter, and cord.

The $3,299 Micron GoBook has the longest battery life in this roundup at 6:33. The unit achieves this through a standard, but external, battery that adds about 2.5 pounds to the GoBook's trim 4.9 system weight; when ready for travel with this battery, the unit weighs 8.2 pounds. The GoBook also comes with an internal battery with a tested battery life of 1:41; using both batteries, the unit lasted 8:29 on our BatteryMark test. The GoBook has a 12.1-inch TFT screen and a Pentium II/266.

The Editors' Choice-winning $3,100 IBM ThinkPad 560X also earns notice as the road warrior's machine of choice, expertly balancing weight and battery life. It lasted nearly 4 hours on our battery test, and this single-spindle unit weighs just 5 pounds. It has a Pentium MMX/233, a 12.1-inch TFT screen.

Among the high-end notebooks, the $3,000 FutureTech FutureMate 6300XL2 and the $2,499 Maximus Powermax XGA CD Book both stood out. The 9.2-pound FutureMate is hefty but lasted 4:02, while the 8.4-pound Maximus could manage only 1:12. Interestingly, the FutureMate used a more power-hungry CPU, the Pentium II/266, while the Maximus unit used a Pentium MMX/233. Both had 13.3-inch active-matrix screens and used lithium ion batteries.

In the value class, both the $2,300 Hitachi VisionBook Plus and the $3,250 MetroBook LT show their road warrior mettle. The VisionBook weighs just 6.8 pounds ready for travel, has a 13.3-inch active-matrix LCD and lasted 4:02 on our BatteryMark test, while the MetroBook weighs 8.6 pounds, has a 12.1-inch HPA LCD (a sharper and more brilliant version of a passive matrix screen than standard DSTN models) and lasted 4:32. Both used Pentium MMX/266 CPUs.

The ARM unit could not complete our battery test, possibly because of an incompatibility with our test or a problem with its power management functions.—*Analysis written by Mary E. Behr*

	Travel weight Pounds	Main battery weight Pounds	ZD BatteryMark 2.0 Hours:minutes	Battery life per pound of battery weight Hours:minutes
High-end notebooks				
Alcam XL791	7.4	0.9	3:58	4:24
AMS Rodeo 5032ECX	9.5	1.3	2:32	1:57
ARMNote TS759	9.2	1.3	N/A	N/A
Brick Ergo BigScreen[4]	9.3	1.0	2:32	2:32
Compaq Armada 7800	9.0	0.9	1:52	2:04
Dell Latitude CPi D266XT	7.4	0.8	3:03	3:49
Digital HiNote VP 765	8.2	0.9	2:42	3:00
Fosa AP 8800M	11.3	1.1	2:38	2:24
FutureTech FutureMate 6300XL2	9.2	1.2	4:02	3:22
Gateway Solo 9100LS	9.7	1.3	2:52	2:12
HP OmniBook 7100	9.5	1.3	3:32	2:43
HP OmniBook 4100	7.6	1.0	3:01	3:01
IBM ThinkPad 770ED	9.0	1.0	3:52	3:52
Maximus Powermax XGA CD Book	8.4	1.0	1:12	1:12
MaxTech YesBook X759	9.2	1.3	3:01	2:19
MetroBook DT	11.4	1.5	3:12	2:08
NEC Versa LX	8.2	1.1	2:59	2:43
ProGen Venture MMX266	8.4	1.0	2:52	2:52
Quantex H-1331 with PII/266MHz	7.3	0.8	2:02	2:33
Royal Mobile Pro II	9.2	1.0	2:02	2:02
Sceptre SoundX 5500T	7.6	0.9	2:32	2:49
Toshiba Tecra 780DVD	8.9	1.1	3:43	3:23
Transmonde Vivante SE 2266	8.4	1.3	3:28	2:40
Transmonde Vivanté XL 2266	8.2	0.9	2:02	2:16
Twinhead Slimnote XL	8.3	0.8	3:23	4:14
WinBook XLi	8.4	1.0	2:18	2:18
Value notebooks				
Acer Extensa 367D	7.3	0.9	3:12	3:33
ACT Innomation 5133LE	8.6	0.9	1:51	2:03
Alcam XL662	6.8	1.0	4:19	4:19
AMS TravelPro 2500CS	8.6	1.3	2:19	1:47
ChemBook 3300	8.0	1.3	2:30	1:55
Compaq Presario 1640	8.1	0.9	3:32	3:56
Compaq Armada 1571DM	7.9	0.9	3:10	3:31
Dell Inspiron 3000 M233XT	8.1	0.9	2:53	3:12
DFI 6730	8.6	0.9	2:02	2:16
Digital HiNote Ultra2000 GTX 5266M	7.3	1.2	4:01	3:21
DTK FortisPro Top5A233	7.8	1.0	2:52	2:52
Fosa AP 6100T	8.7	0.9	2:20	2:36
Gateway Solo 2500SE	7.7	1.3	5:01	3:52
HP OmniBook 2100	7.4	1.2	3:19	2:46
Hitachi VisionBook Plus 5290	8.6	1.1	4:32	4:07
IBM ThinkPad 380XD	8.0	0.7	3:10	4:31
Maximus Medianote CD Book	8.6	1.3	1:59	1:32
MetroBook LT	6.8	1.0	4:02	4:02
Micron TransPort Trek	7.6	1.0	3:09	3:09
Mitsuba Dynasty 500	8.0	1.0	1:12	1:12
Sharp PC-M200	9.7	0.9	2:30	2:47
Toshiba Satellite 335CDS	7.2	0.9	2:52	3:11
Twinhead Slimnote 9TE	7.8	1.0	2:52	2:52
WinBook XL 233	8.6	1.4	2:29	1:46
Subnotebooks				
IBM ThinkPad 560X	5.0	0.7	3:59	5:41
IBM ThinkPad 600	6.5	0.7	3:12	4:34
Micron GoBook	8.2	2.5	6:33*	2:37
NEC Versa SX	6.2	0.8	2:22	2:58

* Using the standard external battery, with the single internal battery, the BatteryMark score is 1:41 and travel weight drops to 5.6 pounds with both batteries together, the score is 8:29. N/A—Not applicable. The ARM product did not complete this test.

Service & Reliability

We rate vendors for which we received at least 50 responses in our latest Service and Reliability Survey of 17,000 subscribers. We analyzed the data using a *t-test*, a standard statistical procedure for identifying differences from the average that are significant at the 95 percent confidence level. For details, see page 219 of our issue of July 1998. The **satisfaction** rankings reflect respondents' experience with **reliability, repair,** and **technical support** over the past two years. **Units needing repair** refers to the proportion of the notebooks that the respondents said needed repair during the past year. In this category, "significantly better than average" means the incidence of needed repairs was lower than average.

▲ Significantly better than average
○ Average
▼ Significantly worse than average

	Satisfaction with			Units needing repair over the past 12 months
	Reliability	Repair	Technical support	
Acer	○	○	○	○
Compaq	▼	○	○	○
Dell	▲	▲	▲	▲
Gateway	▲	▲	▲	▲
Hewlett-Packard	○	○	○	○
Hitachi	○	○	○	○
IBM	▲	▲	▲	○
Micron	▲	▲	▲	○
NEC	○	○	○	○
Toshiba	▲	○	▼	○
WinBook	○	○	○	▼

business use, had performance scores that were below average but acceptable considering the system's low price.

The 367D comes with a 12.1-inch DSTN screen that has a maximum internal 800-by-600 resolution. The screen is the biggest compromise in the system: it's one of the better dual-scan displays we tested, but it's still not as bright as an active-matrix panel.

There were no operational surprises with this notebook. It offers a USB port and CardBus support; both worked well. The unit has a fixed 24X CD-ROM drive, and the only way to use a floppy disk drive with the 367D is to attach the standard unit externally. Hard disk swapping is literally a snap, though.

Acer also offers a notebook in the presentation and desktop-replacement category. Targeted specifically at small- to medium-size businesses, the Pentium II/233–based Extensa 710TE (not reviewed) offers a three-spindle design. Acer plans to offer a 266-MHz Pentium II version of the 710TE, the 711TE, in August.

A one-year warranty and toll-free 24-hour, 7-day technical support are included, but there is no on-site service. The 367D offers solid value.—*Bruce Brown*

Alcam XL791, XL662

XL791: Pentium MMX/266, 13.3" TFT, 3.9GB disk, 64MB EDO DRAM, 6.8 lbs. Battery: 3:58. Winstone 98: 15.9. $2,400 street.
XL662: Pentium MMX/200, 12.1" TFT, 3.1GB disk, 32MB EDO DRAM, 6.1 lbs. Battery: 4:19. Winstone 98: 14.3. $1,590 street. Alcam Notebook Co., 888-292-5226, 508-393-5757; www.alcam.com. 502 at www.pcmag.com/infolink.

●With impressive battery life and respectable performance, coupled with some good prices, Alcam's high-end XL791 and value XL662 multimedia notebooks hold their own within their categories.

Both systems use the same case, which offers a comfortable keyboard and a touch pad as well as two speakers embedded in the wrist rest. The units have a modular drive bay that can hold a 20X CD-ROM drive or a floppy disk drive; the latter can be used externally. (Neither system supports a DVD drive; a DVD line of notebooks will be available later this year.) Both units come with active-matrix displays. The XL791's panel, however, measures 13.3 inches, supports XGA resolution, and uses the Cirrus Logic GL-CD7556 graphics chip set, while t XL662 has a 12.1-inch SVGA display a uses the NeoMagic MagicGraph 128X chip set. The XL791 also has a larger di (3.9GB versus 3.1GB).

The units use lithium ion batteries a posted excellent times on our BatteryMa test: 4:19 for the XL662 and 3:58 for t XL791. These notebooks also have go travel weights: 6.8 pounds and 7.4 poun for the XL662 and XL791, respectivel Both were average to above-average pe formers within their classes on our tes

Both units came with 56-Kbps P Card fax modems (their $95 cost included in the street price given above The XL791 also offe the following options: $125 10/100-Mbps P Card Ethernet adapte a $49 auto adapter, a $ external battery char er, and a $199 port repl cator, which includes a standard I/O ports an two Type II PC Car slots.

Alcam provides one-year warranty wit guaranteed 48-hou repair service. A three year warranty costs $12 and first-year 24-hou express service is $4 Good prices, great ba tery life, and low trave weights make these unit very appealing.—*Robe S. Anthony*

Acer Extensa 367D

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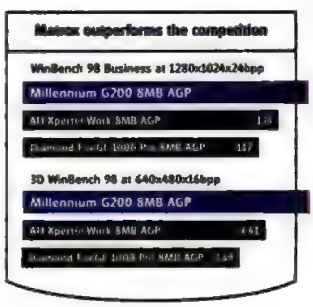

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But with twenty years of experience behind us, we figured Millennium G200 should do more than just shatter all the performance records. That's why it's backed by unified driver support and new time-saving manageability features. So the Millennium G200 is performance you can depend on. Because that's how it should be.

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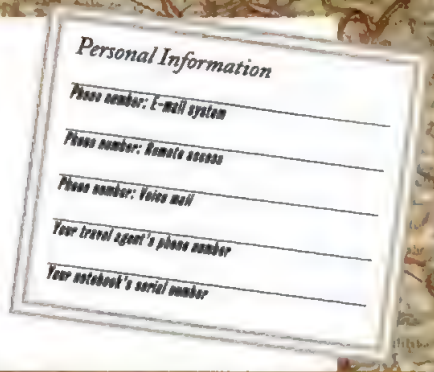
THE ROAD WARRIORS GUIDE



Our 1998 road warrior's guide contains hints for organizing your life before you travel and information you'll need while you're out there. Even the most well-planned trip has emergencies. Having the essentials packed and a list of numbers you need can make a world of difference.

Top Web Sites

The following Web sites offer information of special interest to business travelers.

GENERAL-INTEREST AND NEWS SITES

www.cnn.com CNN. News, sports, business, and weather coverage.
www.nytimes.com *The New York Times.* News, weather, sports, and features.
www.pcmag.com *PC Magazine.* Product reviews and technology updates, top 100 Web site ratings, and daily reports on high-tech news.
travel.state.gov U.S. Department of State. World travel warnings and advisories.
www.wsj.com *The Wall Street Journal.* News, stocks, and company profiles. Requires subscription.
www.usatoday.com *USA Today.* News, sports, business, weather, and features.

WEATHER

www.intellicast.com Intellicast. Weather site linked to NBC for U.S. and foreign weather.
www.weather.com The Weather Channel.

ONLINE RESERVATIONS

www.thetrip.com Air travel reservations, flight status information, airport maps, hotel listings and reviews, city guides, and interactive maps.
www.travelocity.com Airline and hotel reservations, listings of local attractions, and late-breaking discounts.

SPECIALIZED SITES

www.city.net Essential information on top destinations worldwide and low-fare information.
www.citysearch.com Details about daily life in a dozen U.S. cities and several outside the U.S.
www.krollassociates.com/KTS Kroll Travel Watch. Worldwide travel advisories, as well as information on what parts of town to avoid and what to wear. For $19.95, they'll fax you a full City Advisory.
www.mapquest.com Map store plus online directions and a moving expense calculator.
www.rubicon.com/passport.html Rubicon Digital Passport. Interactive currency converter; listings of airports, airlines, embassies, and international holidays.
www.supporthelp.com Technical-support numbers, Web sites, and newsgroups for over 2,500 computer-product vendors.
www.travelersaid.org Travelers Aid International. Aid information and contacts for U.S and foreign cities.
www.travelstuff.com/plglist.html Travelers Emporium. Online list of international electrical/telephone plug and power standards.
www.pathfinder.com/travel/zagat Zagat Survey. Top restaurants in major American cities.

PHONE DIRECTORIES

www.bigyellow.com Big Yellow.
www.four11.com Four11.
www.switchboard.com Switchboard.
www.whowhere.com WhoWhere?

WEB SEARCH ENGINES

www.altavista.digital.com AltaVista.
www.excite.com Excite.
www.hotbot.com HotBot.
www.yahoo.com Yahoo!

Traveler's Checklist

CRITICAL ITEMS:
- ❍ Notebook computer
- ❍ Notebook AC adapter and cables
- ❍ Removable floppy disk drive and CD-ROM drive
- ❍ Modem and connector cable (dongle)
- ❍ RJ-11 phone cord
- ❍ International electrical and phone adapters
- ❍ Business cards
- ❍ Day planner and meeting schedule
- ❍ Cash, traveler's checks, credit cards, local currency
- ❍ Tickets, itinerary, directions
- ❍ Car and hotel confirmation numbers
- ❍ Driver's license, passport, necessary visas

IMPORTANT TASKS:
- ❍ Charge your notebook batteries
- ❍ Change your voice mail message
- ❍ Set up your desktop PC for remote access
- ❍ Transfer working files to your notebook
- ❍ Get dialing codes (for international travel)
- ❍ Get toll (non-800) phone numbers (for international travel)

OPTIONAL ITEMS:
- ❍ Spare notebook battery
- ❍ Hand-held PC (and spare battery)
- ❍ Cellular phone (with charger, spare battery, and car adapter)
- ❍ Pager and spare battery
- ❍ Blank floppy disks
- ❍ Notebook manual
- ❍ In-line RJ-11 coupler (makes two short cords into one long cord)
- ❍ RJ-11 Y splitter (to attach two devices to one jack)
- ❍ Acoustic handset coupler (especially for international travel)
- ❍ 12V DC–to–120V AC converter
- ❍ Short printer cable
- ❍ Three-prong–to–two-prong AC adapter
- ❍ AC extension cord or power strip
- ❍ Blank courier-service airbills and envelopes
- ❍ Phone-line tester (checks for unsafe lines)
- ❍ Toolkit (needle-nose pliers, screwdriver, pocketknife, alligator clips, and flashlight)
- ❍ Spare pointing-stick cap
- ❍ Velcro cable ties

Online Services

You'll need the information here to keep in touch with your favorites.

AOL	800-827-6364, 703-448-8700	800-827-3338	8:00 A.M.–2:00 A.M., 7 days	800-716-0023 ($6.00/hour)	800-827-3338	Keyword access
CSi (CompuServe)	800-848-8990, 614-723-9941	800-944-9871	8:00 A.M.–1:00 A.M. M–F; 10:00–10:00 Sat., Sun.	800-331-7166 ($6.00/hour)	800-848-8990	GO PHONES
MCI Internet	800-662-3709, 202-833-8484	800-348-8011	24 hours, 7 days	800-779-2966	888-624-4887	Go to *www.mci2000.com/LocalAccess/*
The Microsoft Network	800-386-5550	425-635-7019	7:00 A.M.–2:00 A.M. M–F; Noon–10:00 Sat., Sun.	None	800-386-5550	Go to Connection Settings, MSN as Provider, Access Numbers
Prodigy Service Co.	800-213-0992	800-776-3449	24 hours, 7 days	800-777-7997 ($0.10/minute)	800-776-3449	Go to Phone Directory Lookup, use Dial Phone Directory connect option, or go to *www.prodigy.com/learn/whatindx.htm*
SpryNet	800-777-9638	800-557-9614, 425-957-8998	9:00–9:00, M–F	ISDN: 800-473-6282; 56K: 800-572-1959 ($9.00/hour and up)	800-244-4257	Go to *www sprynet.com/members/numbers/*

ISP Information

This chart shows you how to reach your favorite online service from the road.

AT&T WorldNet	28.8: 800-543-3279; 56K (x2): 888-296-3892 ($0.10/minute)	800-967-5363	800-967-5363	330	No	No/Yes
Concentric Network Corp.	800-991-4227 ($6.00/hour)	800-745-2747	800-745-2747	139 plus 16 SuperPOPs	No	Yes/No
Earthlink Network Inc.	800-853-7921 ($4.95/hour)	800-395-8410	800-395-8410	1,142	Yes	Yes/Yes (x2: Calif. only)
GTE Corp.	800-638-1483 ($5.95/hour)	800-927-3000	800-927-3000	550	Yes	Yes/No
IBM	800-590-4857 ($6.00/hour)	800-821-4612	800-455-5056	100	Yes	No/Yes
MCI Internet	800-779-2966 ($5.95/hour)	800-348-8011	800-955-5210	300	No	No/Yes
MindSpring Enterprises Inc.	Info not available	800-719-4660	800-719-4660	257	Yes	No/Yes
Netcom On-Line Communication Services Inc.	800-784-3638 (continental U.S, $4.90/hour; Alaska and Hawaii, $6.95/hour)	888-316-1122, 408-881-1810	800-638-2661	330	Yes	No/Yes
Sprint Corp.	800-659-0090 ($4.80/hour)	800-786-1400	800-786-1400	200	No	Yes/No
SpryNet	ISDN: 800-473-6282; 56K: 800-572-1959 ($9.00/hour and up)	800-557-9614	800-557-9614	514	Yes	No/Yes

AOL and CompuServe (CSi) Access Numbers

Here are local-access numbers for major U.S. cities, as well as some popular international destinations.

Atlanta (404)	865-9846*	841-0578
Austin (512)	464-0013*	326-1155
Baltimore (410)	727-1209*	266-9547
Boston (617)	692-0900†	426-9295
Chicago (312)	470-8500†	201-0711
Cleveland (216)	662-2618†	781-7598
Dallas (214)	760-8211*	720-9183
Detroit (313)	225-4108*	535-1466
Honolulu (808)	537-5300†	528-0430
Houston (713)	287-2210*	650-5143
Las Vegas (702)	382-7740*	796-4877
Los Angeles (213)	239-0123†	624-3730
Miami (305)	358-9147*	262-9325
Minneapolis (612)	321-7940†	339-1805
New York (212)	547-0037†	766-2080
Philadelphia (215)	277-9100†	561-1634
Phoenix (602)	252-1640*	468-0285
Pittsburgh (412)	208-3200†	471-6417
Portland (503)	316-2140*	274-6400
St. Louis (314)	516-0900*	421-5651
San Diego (619)	308-0100†	467-9508
San Francisco (415)	546-0457*	982-0401
San Jose (408)	251-0148*	980-1044
Seattle (206)	812-1916†	515-6000
Washington (202)	756-0001†	547-0103
Amsterdam (20)	682-6015	688-0085
Brussels (2)	705-2380	726-8830†
Frankfurt (69)	2970-5300	7399-8611*
Hong Kong (852)	2519-9040	3002-8332
London	171-572-7444	845-080-1000
Mexico City (5)	628-9393	262-0000
Osaka (6)	578-7230	920-2137
Paris (14)	064-1670	188-0840*
Singapore (65)	546-8101	438-4121
Tokyo (3)	3599-7011	5471-4790
Toronto (416)	364-3400	367-8122
Vancouver (604)	331-0141	739-8194

* K56flex †x2 (Phone numbers without footnotes do not support 56K access.)
** Surcharges apply for AOL access outside the U.S.

Inverted Back

1. Follow instructions on the other side

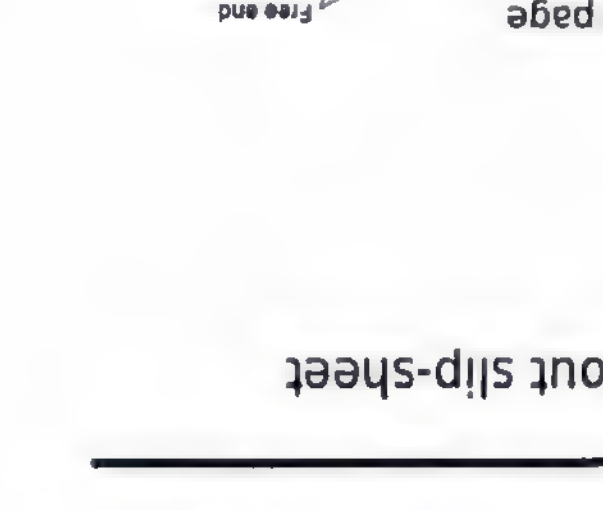
Back

1. Follow instructions on the other side

Folded edge of the page

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



GbsSlipSheet-001

Foldout slip-sheet

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2. Insert this sheet with
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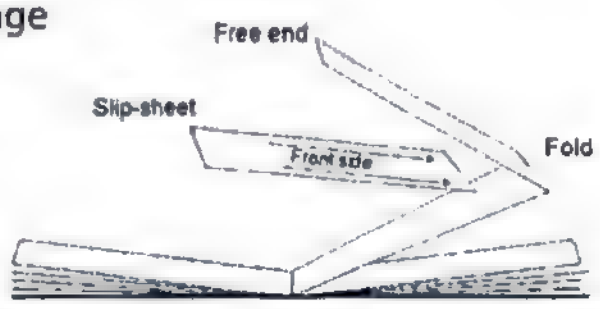

Support Info: Notebook Vendors

Your vendor is the best source for help if you run into trouble while on the road. We give you all the basic support information for the top vendors.

Acer America Corp. (also services TI notebooks)	800-733-2237, 408-432-6200	800-816-2237	www.acer.com/aac	24 hours, 7 days
Apple Computer Inc.	800-538-9696, 408-996-1010	800-500-7078; for extended support options, 888-275-8258	www.apple.com	9:00–9:00 M–F
Compaq Computer Corp.	800-345-1518, 281-370-0670	800-652-6672	www.compaq.com	24 hours, 7 days
Dell Computer Corp.	888-560-8324, 512-338-4400	888-560-8324	www.dell.com	24 hours, 7 days
Fujitsu PC Corp.	888-466-8434, 408-935-8800	800-838-5487, 408-935-1698	www.fujitsu-pc.com	24 hours, 7 days
Gateway	800-846-2000, 605-232-2000	800-846-2301	www.gateway.com	24 hours, 7 days
Hewlett-Packard Co.	800-752-0900, 650-857-1501	970-346-8682, 970-635-1000	www.hp.com	8:00–8:00 M–F
Hitachi PC Corp.	800-555-6820, 408-546-8216	800-448-2244	www.hitachi.com	24 hours, 7 days
IBM Corp.	800-426-2698, 914-766-1900	800-772-2227	www.pc.ibm.com	24 hours, 7 days
NEC Computer Systems Division	888-306-4636, 508-264-8000	800-632-4525	www.nec-computers.com	24 hours, 7 days
Sharp Electronics Corp.	800-237-4277, 201-529-8200	800-237-4277	www.sharp-usa.com	24 hours, 7 days
Toshiba America Information Systems Inc.	800-959-4100, 714-583-3000	800-999-4273	www.toshiba.com	24 hours, 7 days

Little Black Book

Below are the contact numbers or Web addresses for car rental and credit card companies, hotels, airlines, and other services. Note that the Resinnter Group oversees Novotel and Sofitel hotels.

Company	Phone number	Web address
AUTOMOBILE RENTAL		
Alamo	800-462-5266	www.goalamo.com
Avis	800-331-1212	www.avis.com
Budget	800-527-0700	www.budgetrentacar.com
Dollar	800-800-4000	www.dollarcar.com
Enterprise	800-325-8007	www.pickenterprise.com
Hertz	800-654-3131	www.hertz.com
National	800-227-7368	www.nationalcar.com
Thrifty	800-331-9111	www.thrifty.com
LOST CREDIT CARDS		
American Express	800-554-2639	www.americanexpress.com
Diners Club	800 234-6377	www.dinersclub.com
MasterCard	800-826-2181	www.mastercard.com
Visa	800-336-8472	www.visa.com
LODGINGS		
Best Western	800-528-1234	www.bestwestern.com
Courtyard by Marriott	800-321-2211	www.courtyard.com
Doubletree	800-222-8733	www.doubletreehotels.com
Embassy Suites	800-362-2779	www.embassysuites.com
Fairmont	800-527-4727	www.fairmont.com
Four Seasons	800-332-3442	www.fourseasons.com
Hilton	800-445-8667	www.hilton.com
Holiday Inn	800-465-4329	www.holiday-inn.com
Hyatt	800-233-1234	www.hyatt.com
Inter-Continental	800-327-0200	www.interconti.com
ITT Sheraton	800-325-3535	www.sheraton.com
Marriott	800-228-9290	www.marriott.com
Meridien	800-543-4300	www.forte-hotels.com
Omni	800-843-6664	www.omnihotels.com
Quality Inn (Choice)	800-228-5151	www.hotelchoice.com
Radisson	800-333-3333	www.radisson.com
Resinnter Group	800-221-4542	www.hotelweb.fr
Ritz-Carlton	800-241-3333	www.ritzcarlton.com
Westin	800-228-3000	www.westin.com

Company	Phone number	Web address	Your account number
OVERNIGHT DELIVERY SERVICES			
Airborne Express	800-247-2676	www.airborne.com	
DHL	800-225-5345	www.dhl.com	
Federal Express	800-238-5355	www.fedex.com	
UPS	800-742-5877, 800-782-7892*	www.ups.com	

* For international destinations

ACCESSING LONG DISTANCE CARRIERS (IN THE U.S.)		
AT&T	800-225-5288	www.att.com/traveler
MCI	800-888-8000	www.mci.com/aboutyou/interests/international/travelguide
Sprint	800-663-3463	www.sprintbiz.com/dtravel

Carrier	Domestic information	International information	Web address
TRAVEL			
Air France	—	800-237-2747	www.airfrance.com
Alitalia	—	800-223-5730	www.alitalia.it
American	800-433-7300	800-433-7300	www.americanair.com
Amtrak	800-872-7245	—	www.amtrak.com
ANA	—	800-235-9262	www.ana.co.jp
British Airways	—	800-247-9297	www.british-airways.com
Continental	800-525-0280	800-231-0856	www.flycontinental.com
Delta	800-221-1212	800-241-4141	www.delta-air.com
JAL	—	800-525-3663	www.jal.co.jp
Lufthansa	—	800-645-3880	www.lufthansa.com
Mexicana	—	800-531-7921	www.mexicana.com
Northwest/KLM	800-225-2525	800-447-4747	www.nwa.com
Qantas	—	800-227-4500	www.qantas.com
SAS	—	800-221-2350	www.flysas.com
Singapore	—	800-742-3333	www.singaporeair.com
Swissair	—	800-221-4750	www.swissair.com
TWA	800-221-2000	800-892-4141	www.twa.com
United	800-241-6522	800-241-6522	www.ual.com
USAirways	800-428-4322	800-622-1015	www.usairways.com
Virgin Atlantic	—	800-862-8621	www.fly.virgin.com

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With up to 266MHz Intel Pentium® II processor, up to 64MB high speed EDO RAM expandable to 192MB, and up to 8.1 billion bytes of hard drive space, in the power game, you just won

FEATURE-PACKED
All the multimedia bells and whistles. Try DVD or a 20x* CD-ROM, up to 13.3" active-matrix TFT color display, K56Flex upgradeable internal modem, crystal clear sound, even video conferencing.**

Inside the world's best-selling portables lives something of a beast. The new Intel Pentium® II processor. It's at the heart of our ultimately-equipped Tecra™ 780 (a *PC Magazine* Editor's Choice) as well as our updated workaholic, the Satellite Pro™ 490—a perfect balance of power, features and price. Both are built to Toshiba's legendary quality standards. Both

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MONTHLY FINANCING

Now get the new Tecra 780CDM for just $141 a month, and the new Satellite Pro 490CDT for just $99 a month‡. And when your lease is up? Simply return your notebooks.

Number I proudly introduces number II.

feature massive drives and stunning multimedia. Both are fully expandable with PC Cards, CardBus Cards and docking stations. And both are loaded with enough horsepower to handle your most memory-hungry applications. These new portables will definitely get the job done. Beyond a doubt. Or, the shadow of one. For more details, give us a click at www.toshiba.com, or call 1-800-TOSHIBA.

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The World's Best Selling Portable Computers.

36-month lease with 10% down payment and fair market value purchase option at the end of the lease term. Lease rates shown based on Tecra 780CDM at $5,099 and Satellite Pro 490CDT at $3,549 for transactions between $25,000 and $50,000. Other lease options may be available. Rates are subject to change without notice. Offer valid in the U.S. only.

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Call us toll-free and no matter where you are in the world, our Express Notebook Depot repair service will get you up and running in record time.

ATTRACTIVE FINANCING
With our hassle-free financing, you can now lease the Libretto 100CT for just $71 a month.*

It weighs 2.35 lbs. It runs Windows® 95 and NT. It's worth looking into.

and NT compatible with a monstrous 2.1 billion byte hard drive. All encased in a sleek, surprisingly compact package created exclusively by Toshiba. The Libretto 100CT. An accomplished piece of hardware for accomplished professionals, now offered at attractive lease rates. Simply put, don't miss your window of opportunity. Get yours by clicking www.toshiba.com or calling 1-800-TOSHIBA.

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at the end of the lease term. Lease rates shown based on Libretto at $2,499 and for transactions between $25,000 and $50,000. Other lease options may be available. Financing available through Toshiba Financial Services to qualified commercial customers. Rates are subject to change without notice. All specifications and availability are subject to change. Offer valid in the U.S. only.

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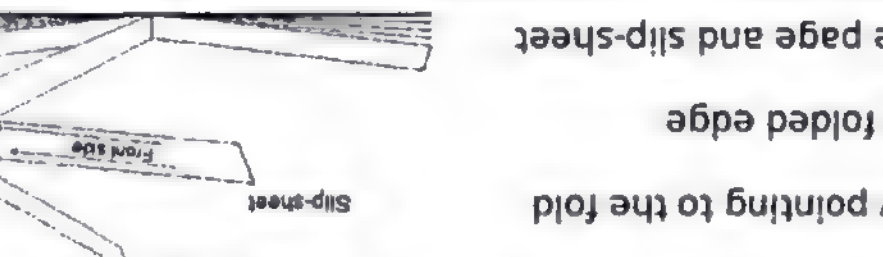
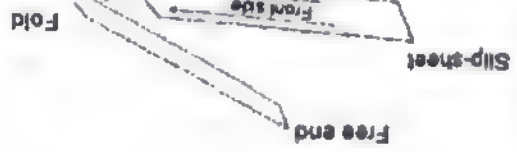


Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

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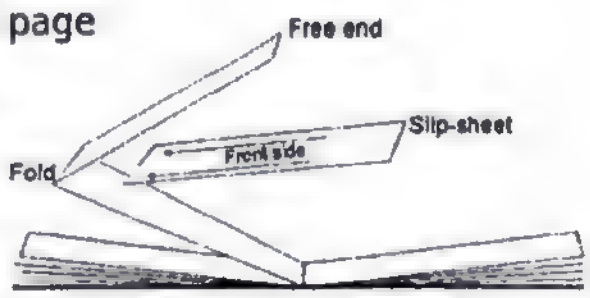
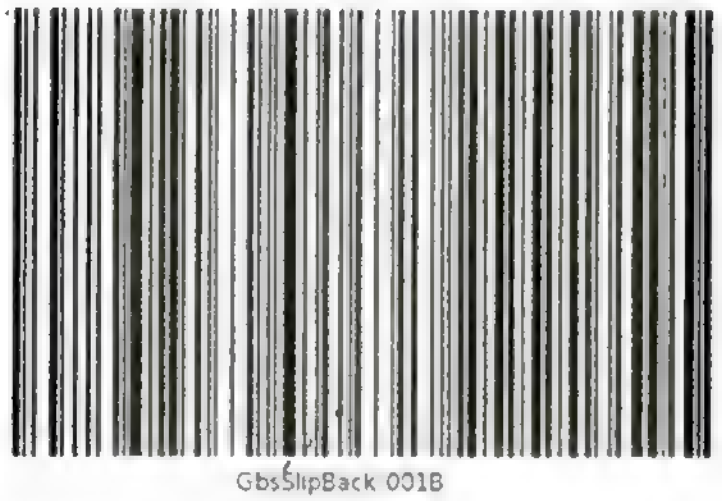
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Back

1. Follow instructions on the other side



Back

1. Follow instructions on the other side

SMALL WONDER
The Libretto 100CT is the world's smallest, lightest, most portable computer designed to run Windows 95 or Windows NT. It's just 8.3"x5.2"x1.4"

HIGH PERFORMANCE
Enjoy a 166MHz Pentium® processor with MMX™ technology, the support of two Type II or one Type III PC Card, optional modem or CD-ROM. It's all there.

Toshiba's Libretto™ 100CT. It's not just a mini-notebook. It's a major milestone. From e-mail and spreadsheets to full-blown presentations, the Libretto 100CT does what a Windows-based desktop does—at half the size of a notebook. You can actually fit *TIME Magazine's* Machine of the Year* in your coat pocket. Highly unusual for a device that's Windows 95

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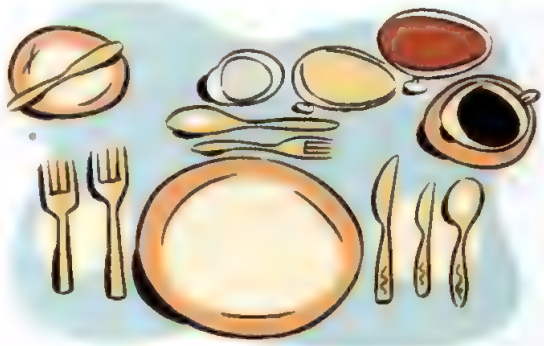
The Right Setting

You'll find your bread plate on the left. Your water glass, along with wine glasses (white, then red), will be on your right. Generally, select knives and forks from the outside in, as the courses progress. Exceptions: the dessert spoon and fork are often above the plate; the butter knife may be found across the bread plate. Signal your server that you've finished by placing your fork—prongs down—and knife—blade facing in—side by side at the four o'clock position. Bon appétit.



Need Accessories?

The following vendors offer all sorts of travel accessories, from security devices to acoustic couplers.

Konexx Unlimited Systems Inc. Hardware accessories such as in-line handset couplers, for telecommuting and for voice and data communication, be it from a pay phone or someone's boardroom. 800-275-6354; *www.konexx.com.*

Mobile Planet Inc. Notebooks, international power adapters, and other miscellaneous mobile accessories. 800-675-2638; *www.mplanet.com.*

1-800-Batteries Not only batteries but also mobile gear and gadgets, as well as cell-phone products. 800-228-8374; *www.800batteries.com.*

PC Connection A last-minute source for hardware and software. Place your order before 2:45 P.M. and you'll have it the next day via Airborne. 800-800-0009; *www.pcconnection.com.*

PC Zone Internet SuperStore Another source for computer hardware and software. If you place your order before 8:00 P.M. Monday through Friday, it will be shipped the same day. 800-408-9663; *www.pcw.zones.com/pc_Zone/Default_pc.htm.*

Road Warrior International This Web site offers Modem Saver line testers and country-specific phone connectors; the Web site also lets you track your Federal Express or UPS orders online. 800-274-4277, ext. 730; *www.warrior.com.*

TeleAdapt Inc. Another source for international power and phone/modem adapters as well as notebook batteries. It also offers a Traveler's Help desk. 408-965-1400; *www.teleadapt.com.*

Travel Tips for Connecting on the Road

Here are our suggestions for easing communication and keeping your hardware safe when you travel.

Protect your modem Buy a modem that has a digital-line guard. Having this feature will keep your modem from being damaged in case you accidentally plug it into a digital PBX or ISDN phone jack.

Disable Call Waiting Data transfers can be cut off by Call Waiting. Dial *70 (or 1170 from a rotary phone) to disable Call Waiting for the next call. If *70 doesn't work, try #70, 70#, or 70*.

Printing Install popular printer drivers on your notebook (such as those for the HP LaserJet and DeskJet or Epson dot-matrix printers, along with generic "text-only" drivers) so you can print anywhere, on almost anyone's printer. The Web sites for HP (*www.hp.com*) and Microsoft (*www.microsoft.com*) offer downloadable printer drivers, as do others. Or you can opt to use your fax modem to "print" to a fax machine.

In-line handset coupler This device lets you connect to the handset jack (as opposed to the RJ-11 jack in the wall) on any phone, including digital PBX phones. This avoids the damage that can be caused by plugging a PC Card modem into a digital phone jack, as well as the hassle of crawling around the floor. (See "Need Accessories?" for listings of dealers.)

Long-distance carrier codes Dial one of these six-digit prefixes before an area code and phone number to use the following long-distance carriers:

AT&T: 102880 or 800-Call-ATT
MCI: 102220 or 800-Collect
Sprint: 103330 or 800-One-Dime

Security Tips

- Don't lose sight of your notebook case as you're waiting for the plane at the gate. Remember that the X-ray machine at airport security will not damage your PC.
- Use the motion-sensing Defcon 1 notebook alarm ($49.95 direct; Port Inc., 800-242-3133) to protect your computer. Be kind to your maid and leave a warning note.
- Use a Kensington MicroSaver lock ($40 street; 800-535-4242) or a similar device to secure your notebook to a desk.
- Tape business cards or address labels to your notebook and AC adapter, but remember not to cover vent slots. Write your name or your company's name on your PC Cards as well.
- Use your notebook's password-protection utility to provide a layer of protection for your data.
- Always shield public phone keypads to protect your calling card number.
- Plug the ends of your modem cable into an in-line coupler or a Y-connector to protect the levers from snagging and breaking. This is especially handy for proprietary PC modem cord dongles.

ILLUSTRATION BY HARRY CAMPBELL

McAfee Nuts & Bolts, because we know exactly how you feel.

How do you see yourself? Intelligent? Savvy? Productive? Choose the wrong PC maintenance tool and another description will undoubtedly come to mind. The smart choice is McAfee Nuts & Bolts. Compared to Norton, McAfee gives you much better control over system diagnosis, optimization and deadly crashes. That's why PC Magazine gave it their **1998 PC Magazine Editors' Choice Award.** So get reliable Nuts & Bolts and get back to feeling like yourself again. Visit www.mcafee.com/dummy1 or your local retailer.

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Choose 301 at www.pcmag.com/infolink

ACT Innomation 5133LE

Pentium MMX/233, 13.1" TFT, 3GB disk, 32MB SDRAM, 7.8 lbs. Battery: 1:51. Winstone 98: 15. $2,198 direct. All Computer Technology, 800-775-1953, 626-369-4181; www.allcomp.com. 503 at www.pcmag.com/infolink.

● The advantages of strong graphics performance and numerous connectivity options are offset by a large case and a short battery life in All Computer Technology's 5133LE. Overall, however, the unit is an acceptable value notebook.

The modular 5133LE has a large case (12.3 by 10.3 inches) for a unit with a 13.1-inch active-matrix XGA display. That case is stocked with a USB port, an NTSC/PAL video-out port, an expansion bus for a docking station, a Fast IR port, and a MIDI port, in addition to standard I/O ports. The combination 20X Mitsumi CD-ROM/floppy disk drive module can be swapped for a second lithium ion battery.

A set of audio jacks and a volume wheel for a 16-bit wavetable audio subsystem are conveniently located on one side of the unit. Its Synaptics touch pad, however, lies dead-center in the wrist rest area instead of under the Spacebar, which would be a better position for touch-typing. The mouse buttons are on either side.

The 5133LE's S3 ViRGE/MX graphics chip set and 4MB of SGRAM helped it post an above-average score on our Business Graphics WinMark 98 test. The system yielded average scores on our other benchmark tests.

The unit has a travel weight of 8.6 pounds, and its lithium ion battery lasted

Coping with the Heat

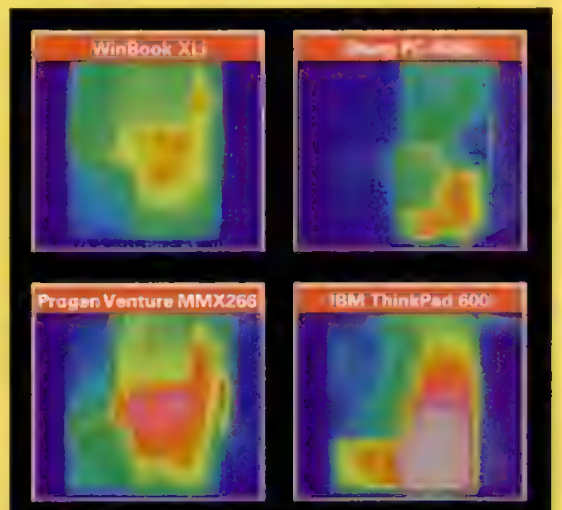
This roundup's notebooks—with their large screens, fast CPUs, large hard disks, and small sizes—face special heat problems. Poor heat distribution can result in overheating, which can lead to severe performance hits and reliability problems. To determine the amount of heat being generated and locate problematic hot spots, we imaged each notebook using infrared imaging technology. All images will be posted on our Web site (*www.pcmag.com*). Here, you see a sample of the data we gathered; we chose systems that represent a range of engineered heat distribution.

Our process measures temperatures between 14 and 392 degrees Fahrenheit. The imaging system correlates this measurement of infrared emission to surface temperature and displays a color image. The grayish-purple areas are the hottest (115 to 150 degrees), the red areas are hot (103 to 114 degrees), the yellow (98 to 102 degrees) and green areas (92 to 97 degrees) are medium-hot, and the blue areas (79 to 91 degrees) are fairly cool. Online, we've also highlighted four spots with the letters A, B, C, and D to indicate different temperature readings.

TEST SETUP

To create a realistic thermal scenario, we placed notebooks on a flat surface and ran each on battery power for 30 minutes using our ZD Business Winstone 98 test suite. Power management, which will slow down CPUs and spin down disks, was disabled.

The infrared camera was placed at a fixed distance and took two images: one of the bottom of the notebook, and the other, a view of the keyboard. This was completed in less than 20 seconds to prevent any changes in temperature.



THERMAL DESIGN is one of the most difficult areas of notebook engineering. Hot spots—areas with temperatures of 120 to 140 degrees Fahrenheit (represented here by the grayish-purple and red colors)—are to be avoided. The Sharp and WinBook units do a good job of distributing heat evenly.

FINDINGS

Any surface area with a temperature of 140 degrees Fahrenheit is noticeable and uncomfortable. Even temperatures from 120 to 140 degrees may feel uncomfortable, especially after 2 hours of use. The most efficient thermal designs spread heat evenly throughout the system, avoiding hot spots. While the top of the notebook benefits from airflow through the keyboard, the underside generally does not promote quick heat dissipation and therefore is the most critical area in thermal design. Not surprisingly, this is where we found the highest temperatures. Overall, the CPU is the hottest component, followed by the power supply and the hard disk.

We noted very different approaches to thermal design, ranging from metal conductors, heat spreaders, and heat pipes to miniature fans (which were not engaged during heat testing) and carefully engineered airflow paths.

Hot spots ranging from 115 to over 125 degrees as detected on the surface of our IBM and ProGen units (shown here) are still common. Moderate temperatures or even distribution of heat as shown in the Sharp and WinBook units are rare but should become a focus of notebook engineering.

ACKNOWLEDGEMENTS

Photographs were taken with the Modular Thermal Imaging System and Thermal Image Processing software from Mikron Instrument Co. (201-405-0900, *sales@mikroninst.com*). We appreciate the support we received from Mikron's president, K. Irani, and Mikron's computer engineer, Wlodek Czeczot.
—By Oliver Kaven

"i heard him
yell something about crashing,
and then there was silence."
Prevent this from happening to you with McAfee's Safe & Sound.
It's easy. Install it and leave it alone. It keeps things from going
wrong with your PC. And if it does find something wrong, it'll
fix it for you. Best of all, it backs up your data automatically.
So please, use Safe & Sound and save yourself the grief.
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just 1:51 on our BatteryMark test. ACT backs the unit with a one-year warranty. If you don't need a product with a long battery life, you may be satisfied with this unit.—*RSA*

AMS Rodeo 5032ECX, TravelPro 2500CS

Rodeo 5032ECX: Pentium II/266, 14.1" TFT, 3.9GB disk, 64MB SDRAM, 8.7 lbs. Battery: 2:32. Winstone 98: 18.7. $3,800 street.
TravelPro 2500CS: Pentium MMX/233, 12.1" TFT, 3.1GB disk, 32MB SDRAM, 7.8 lbs. Battery: 2:19. Winstone 98: 13.5. $1,700 street. AMS Tech Inc., 800-886-2671, 626-814-8851; www.amstech.com. 504 at www.pcmag.com/infolink.

● The extremes of AMS Tech's notebook arsenal are represented by its high-end Rodeo 5032ECX and value TravelPro 2500CS units. Both systems offer some good hardware at a fair price, but only the Rodeo kept up with the competition on our tests.

The Rodeo has a travel weight of 9.5 pounds and comes with an integrated 56-Kbps fax modem and an NTSC/PAL video-out jack for presentations. A 20X CD-ROM drive can be swapped for a second battery or a DVD module ($400), which should be available by the time you read this. A Trident Cyber 9397 3-D graphics chip set ran the big 14.1-inch active-matrix XGA display and contributed to an above-average score on our Business Graphics WinMark 98 tests. The unit had an average score on our Business Winstone 98 tests and below-average scores (for its high-end class) on both our hard disk and CD-ROM tests.

Weighing in at 8.6 pounds (travel weight), the TravelPro came with a noticeably slow 12.1-inch SVGA dual-scan display run with a NeoMagic MagicGraph 128XD graphics chip set and 2MB of DRAM. The unit yielded below-average scores for its class on both our Winstone and Graphics WinMark tests but was an average performer on the remaining tests. Active-matrix LCDs measuring 12.1 and 13.3 inches are also available as options with other TravelPro models.

The Rodeo's lithium ion battery lasted 2:32 on our BatteryMark test, and the TravelPro—using a nickel hydride battery—lasted 2:19. AMS Tech offers a three-year parts-and-labor warranty on each unit and a one-year warranty on the battery.

In these units, good prices and current hardware are offset by some uneven results on our tests.—*RSA*

ARMNote TS759

Pentium II/266, 14.1" TFT, 4.8GB disk, 64MB EDO DRAM, 8.4 lbs. Battery: N/A. Winstone: 19.2. $3,000 street. ARM Computer Inc., 800-765-1767, 408-935-9800; www.armcomputer.com. 505 at www.pcmag.com/infolink.

● ARM Computer's high-performance desktop replacement is a rarity: Its $3,000 street price gets you a Pentium II CPU, a well-designed chassis, and myriad upgrade options. The unit could not complete our BatteryMark test, however, because of either an incompatibility with our BatteryMark test or a problem with its power management features.

Though this slate-gray notebook is slightly larger (2 by 12.5 by 10 inches) and heavier (9.2 pounds when ready for travel) than the average portable, it has three spindles—meaning that you can have your hard disk, floppy disk, and CD-ROM drive all running at the same time—and offers support for every conceivable modular option. Its floppy disk drive is integrated, while a port-side bay can accommodate a Toshiba CD-ROM drive, a DVD drive ($399), Zip Drive ($249), a second hard disk ($599), or a second lithium ion battery ($199).

The system's keyboard is relatively quiet and resilient. A touch pad and its mouse buttons, sitting within an ample palm rest, are a bit stiff and require some practice. Upgrading and adding peripherals, however, is effortless: The ARMNote's disk and its memory slots can be quickly accessed with a screwdriver, and each of its port and PC Card covers is conveniently retractable. A Trident Cyber chip set contributed to the lowest Graphic WinMark score in this unit's class, but the machine's CD-ROM WinMark result was among the highest in our roundup.

The ARMNote is a poor graphics performer relative to the high-end competition but is otherwise an adroit machine. —*Cade Metz*

Brick Ergo BigScreen4

Pentium MMX/266, 14.1" TFT, 4.8GB disk, 64MB SDRAM, 8.6 lbs. Battery: 2:32. Winstone: 16.8. $2,995 direct. The Brick Computer Co., 800-495-3746, 978-535-7510; www.ergo-computing.com. 506 at www.pcmag.com/infolink.

● The Ergo BigScreen4, a typical high-end machine save for its Pentium MMX CPU, is designed for mobile presenters and graphics artists. Though bulky, it affords easy access to all major hardware components. It also offers a large 14.1-inch screen and average performance.

ARMNote TS759

With a travel weight of 9.3 pounds, the BigScreen4 is cumbersome, but its bulk allows for versatility. It has a three-spindle design with not one but two modular drive bays that hold a floppy disk drive and a CD-ROM drive. You can swap the floppy disk for a Zip Drive ($250), an LS-120 drive ($200), a second hard disk ($300 to $700), or a second lithium ion battery ($169), and you can swap the CD-ROM drive for a DVD module ($300).

These modular components and the primary battery are easily removed by pressing latches on the

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bottom of the unit. Access to other components is slightly less conventional: Removing the palm rest reveals the IBM hard disk, and the keyboard—a noisy but relatively comfortable model—pops off to expose two memory slots. A panel on the unit's underside, fastened by screws, allows access to the CPU.

In an unusual design, the BigScreen's USB ports reside in different locations. The first sits in the rear of the machine with all the other I/O ports while a second sits behind one of two rear retractable feet. The unit's port covers do not retract. Overall performance was average for its class, but the system did manage above-average scores on the Disk WinMark tests.

If you can handle the unit's weight, you may enjoy the versatility, performance and four-year warranty of the Brick Ergo BigScreen[4].—*CM*

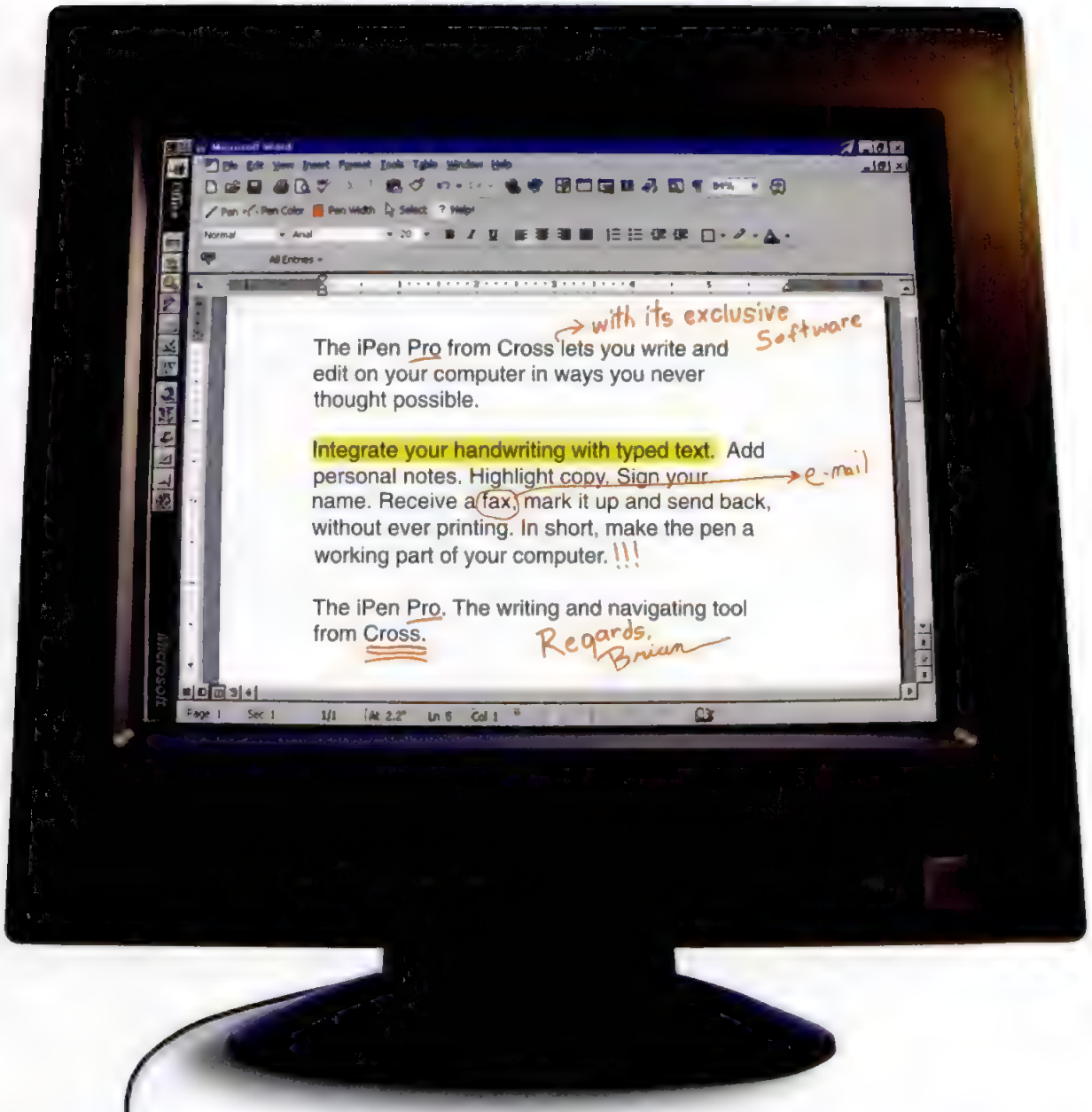
ChemBook 3300

Pentium MMX/233, 12.1" TFT, 3GB disk, 32MB EDO DRAM, 7.3 lbs. Battery: 2:30. Winstone 98: 14.4. $1,499 direct. Chem USA Corp., 800-866-2436, 510-608-8818; www.chemusa.com. 507 at www.pcmag.com/infolink.

●For a value multimedia notebook, Chem USA Corp.'s ChemBook 3300 offers a reasonable array of hardware features but lags behind its competition in terms of graphics performance. Chem USA offers various styles of ChemBooks, which can also be configured with Pentium II CPUs.

Weighing in at 8 pounds when ready for travel, the 3300 comes with a Pentium MMX processor, a fixed floppy disk drive, a 20X CD-ROM drive, and a 12.1-inch active-matrix SVGA display. You'll find the keyboard offers a solid feel and a touch pad is nestled into the large wrist rest. The unit supports 3-D audio by means of an ESS Technology ES1869 audio chip set. It also has two speakers located below the LCD and one USB port.

The 3300 lasted 2:30 on our BatteryMark test; this is a reasonably good result for a unit that uses a nickel hydride battery as opposed to the more robust lithium ion cells. (A lithium ion battery is a $150 option.) The system posted average scores on most of our tests but yielded a below-average score on our Business Graphics WinMark 98 tests.



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BENCHMARK TESTS

Notebooks

PC MAGAZINE LABS

With faster CPUs, faster 2-D and—for the first time—3-D graphics acceleration, notebooks are narrowing the performance gap, compared with their desktop counterparts.

Our ZD Business Winstone 98 results reflect the wide variance in system performance you can get, given the three categories of systems that we tested—high-end, value, and subnotebook. As expected, systems with Pentium II processors, found mostly in our high-end category, sit on top of the performance heap. Three high-end systems, the Compaq Armada 7800, the HP OmniBook 7100, and the IBM ThinkPad 770ED, earned the best results, each scoring over 20. Their combination of Pentium II/266 processors, 4,900-rpm IBM hard disks, and good 2-D graphics performance (using S3 ViRGE/MX, ATI Rage LT Pro, and Trident Cyber 9397 chip sets, respectively) powered the systems to near ties for first place.

You need to make trade-offs if you require a subnotebook, but performance doesn't have to be one of those trade-offs. The NEC Versa SX comes with a Pentium II processor, and its results place the unit near the top performers in this roundup. Part of the disparity can be attributed to differences in RAM: We tested subnotebooks with 32MB, whereas we tested high-end systems with 64MB. The Versa SX was also hampered by its slightly slower hard disk. Subnotebooks use hard disks that are 12.5 mm or thinner (as opposed to the 17-mm disks often found in other notebook categories) whose rotational speeds can't currently match those of their thicker cousins.

The Sharp PC-M200 was unable to run our Winstone tests because it had a graphics driver problem. We worked with the vendor to resolve the problem, but Sharp was not able to resolve it in a reasonable amount of time; we list its score as N/A (not applicable).

With an amazing 6 hours 33 minutes, the Micron GoBook led the field on our ZD BatteryMark 2.0 test. To achieve that timing, the Micron unit uses a large, flat battery that attaches to the bottom of the notebook and weighs a hefty 2.5 pounds. The Micron's travel weight goes from 5.6 pounds to 8.2 pounds with this standard external battery: If you're a serious road warrior, you may want to think twice. Using just the internal battery results in a more pedestrian score of 1:41; with both batteries together, life is 8:29.

The next highest scorer was the value-class Gateway Solo 2500SE. The unit (7.7 pounds travel weight) combined a lithium ion battery and some good power management to last 5:01 on our test.

Much has been said of the loss of battery life when using Pentium II processors instead of Pentium MMX processors. Although we noted differences in previous tests, this time we saw almost no difference. The tested 266- and 233-MHz Pentium MMX systems lasted only 3 minutes longer on the average than their 266- and 233-MHz Pentium II counterparts. But the systems with the AMD K6 266- and 233-MHz processors lagged about 40 minutes—almost 30 percent—behind their Pentium MMX counterparts.

Not surprisingly, the top performers on the ZD Business Graphics WinMark 98 tests had Pentium II/266 processors, but their graphics chips were from different manufacturers. Chips from ATI, NeoMagic, and S3 powered the top high-end performers. In the value catego-

Bold type denotes first place within each category.
denotes Editors' Choice

	CPU	ZD BUSINESS WINSTONE 98
HIGH-END NOTEBOOKS		
Alcam XL791	P MMX/266	18.9
AMS Rodeo 5032ECX	P II/266	18.7
ARMNote TS759	P II/266	19.2
Brick Ergo BigScreen⁴	P MMX/266	16.8
Compaq Armada 7800	P II/266	**20.5**
Dell Latitude CPi D266XT	P II/266	18.6
Digital HiNote VP 765	P II/266	18.8
Fosa AP 8800M	P MMX/266	16.7
FutureTech FutureMate 6300XL2	P II/266	18.5
Gateway Solo 9100LS	P II/266	19.9
HP OmniBook 7100	P II/266	20.3
HP OmniBook 4100	P II/266	19.4
IBM ThinkPad 770ED	P II/266	20.1
Maximus Powermax XGA CD	P MMX/233	12.2
Maxtech YesBook X759	P II/266	18.5
MetroBook DT	P MMX/266	18.4
NEC Versa LX	P II/266	19.9
ProGen Venture MMX266	P MMX/266	16.7
Quantex H-1331 with PII/266MHz	P II/266	18.6
Royal Mobile Pro II	P MMX/233	15.9
Sceptre SoundX 5500T	P MMX/266	16.6
Toshiba Tecra 780DVD	P II/266	19.9
Transmonde Vivanté XL 2266	P II/266	17.8
Transmonde Vivanté SE 2266	P II/266	17.7
Twinhead Slimnote XL	P MMX/266	14.9
WinBook XLi	P II/266	19.1
VALUE NOTEBOOKS		
Acer Extensa 367D	P MMX/200	12.8
ACT Innomation 5133LE	P MMX/233	15.4
Alcam XL662	P MMX/200	14.3
AMS TravelPro 2500CS	P MMX/233	13.5
ChemBook 3300	P MMX/233	14.4
Compaq Presario 1640	AMD K6/266	14.7
Compaq Armada 1571DM	P MMX/200	13.4
Dell Inspiron 3000 M233XT	P MMX/233	14.8
DFI 6730	P MMX/200	15.1
Digital HighNote Ultra2000	P MMX/266	14.7
DTK FortisPro Top5A233	P MMX/233	14.8
Fosa AP 6100T	P MMX/233	13.0
Gateway Solo 2500SE	P II/233	17.7
Hitachi VisionBook Plus 5290	P MMX/266	16.5
HP OmniBook 2100	P MMX/200	14.8
IBM ThinkPad 380XD	P II/266	**19.3**
Maximus Medianote CD Book	P MMX/200	10.8
MetroBook LT	P MMX/266	16.5
Micron TransPort Trek	P MMX/266	15.6
Mitsuba Dynasty 500	AMD K6/266	15.4
Sharp PC-M200	P MMX/200	N/A
Toshiba Satellite 335CDS	P MMX/266	14.4
Twinhead Slimnote 9TE	P MMX/200	9.2
WinBook XL 233	AMD K6/233	14.7
SUBNOTEBOOKS		
IBM ThinkPad 600	P II/266	17.8
IBM ThinkPad 560X	P MMX/233	15.1
Micron GoBook	P MMX/266	15.9
NEC Versa SX	P II/266	**18.8**

N/A—Not applicable. A graphics driver problem prevented the Sharp unit from running this test.

BETTER ▶

▲ Notebooks are edging closer to desktops in performance, at least in the typical business applications measured by Winstone 98. The top performers in this roundup all had Pentium II processors—as you would expect—combined with fast 2-D graphics from the ATI Rage LT Pro or the S3 ViRGE/MX chip sets and relatively fast, 4,900-rpm hard disks, such as found in the Compaq Armada 7800 and HP OmniBook 7100. SDRAM didn't seem to make that much of a difference, as EDO and SDRAM were interspersed among the leaders.

ry, the top score belonged to the IBM ThinkPad 380XD, which used the NeoMagic MagicGraph 128XD. The NEC Versa SX, the first-place subnotebook, used the Trident Cyber 9388.

For the first time, we saw AGP implementations in notebooks: The high-end unit from Compaq used AGP graphics from S3. AGP primarily aids 3-D performance by using system memory for large texture maps; it can accelerate 2-D operations by transferring bitmaps at 66 MHz, but we saw little impact on our 2-D tests. The NEC unit tied for first with the HP OmniBook 7100 and the Compaq model came in second, but this is a reflection of a powerful 2-D accelerator and optimized drivers rather than AGP.

With 40 systems featuring combination 2-D and 3-D accelerators, it's clear that 3-D has arrived on notebooks. Although 3-D acceleration won't help the typical business application, a growing number of 3-D applications as well as games can always take advantage of the 3-D speed. The ATI Rage LT and LT Pro, NeoMagic MagicGraph 128XD, Trident Cyber 9397 and S3 ViRGE MX all support 3-D acceleration features. On informal testing, we used the ZD 3D WinMark test suite to compare some ATI Rage LT systems with their desktop counterparts (ATI is the only company that has similar desktop and notebook 3-D graphics chip sets). Our results show nearly identical 3D WinMark scores when the notebook and desktop systems are similarly configured.

The Alcam XL791, Mitsuba Dynasty 500, and Sharp PC-M200, were unable to run our graphics tests, because of graphics driver problems the vendors were unable to fix. They receive N/As.

Disk performance is an area in which notebooks are clearly lagging behind desktops. The best desktops use disks that spin at 7,200 or 5,400 rpm, while the top notebooks' disks spin at 4,900 rpm; many use 4,000-rpm disks. Our disk tests clearly favored systems using 4,900-rpm disks and Pentium II/266 processors. One exception was the roundup's top performer, the high-end HP OmniBook 4100, which was the only system to use an IBM DADA-26480 disk. This new disk from IBM is the first to use giant magnetoresistive (GMR) head technology. GMR permits increased areal density on the disk, which reduces the number of disks and heads required to reach different storage capacities. The high data throughput and areal density enables the disk to read data faster than traditional 4,900-rpm disks, even though it spins at 4,200 rpm. Ultra DMA support didn't seem to have a major effect on performance in this roundup.

With so many different processors in this roundup, the ZD CPUMark$_{32}$ becomes a good positioning tool for processor performance. Again as expected, the Pentium II/266 systems performed best. Although only one system, the Gateway Solo 2500SE, used a Pentium II/233 CPU, it performed better than bottom-tier Pentium II/266 systems. Other factors that vendors set in BIOSes, such as cache and memory timings, affected CPU subsystem performance.

With equal memory and L2 cache, AMD K6/266 systems bested Intel Pentium MMX/266 units by about 10 percent. Though better than Pentium MMXs, the AMD CPUs are still no match for the Pentium II, which beat the AMD K6 by 27 percent.

Proper BIOS settings can be critical. The Twinhead Slimnote 9TE has a Pentium MMX/200 CPU, yet its score is about half of the Pentium MMX/200 average. The unit came to us using the Auto Configuration with Fail Safe setting, which turns off L2 cache and inserts more cycles in the main memory timings.

Given that 24X (maximum) CD-ROM drives are the fastest available for notebooks, these units naturally lag behind desktops in performance: 32X-maximum drives are the norm for desktops. Systems using Toshiba 24X drives were consistently our top performers.

continues

Bold type denotes first place within each category.
denotes Editors' Choice

	CPU	ZD BATTERYMARK 2.0 Hours:minutes
HIGH-END NOTEBOOKS		
Alcam XL791	P MMX/266	3:58
AMS Rodeo 5032ECX	P II/266	2:32
ARM ARMNote TS759	P II/266	N/A
Brick Ergo BigScreen[1]	P MMX/266	2:32
Compaq Armada 7800	P II/266	1:52
Dell Latitude CPi D266XT	P II/266	3:03
Digital HiNote VP 765	P II/266	2:42
Fosa AP 8800M	P MMX/266	2:30
FutureTech FutureMate 6300XL2	P II/266	4:02
Gateway Solo 9100LS	P II/266	2:52
HP OmniBook 7100	P II/266	3:32
HP OmniBook 4100	P II/266	3:01
IBM ThinkPad 770ED	P II/266	3:52
Maximus Powermax XGA CD	P MMX/233	1:12
MaxTech YesBook X759	P II/266	3:01
MetroBook DT	P MMX/266	3:12
NEC Versa LX	P II/266	2:59
ProGen Venture MMX266	P MMX/266	2:52
Quantex H-1331 with PII/266MHz	P II/266	2:02
Royal Mobile Pro II	P MMX/233	2:03
Sceptre SoundX 5500T	P MMX/266	2:32
Toshiba Tecra 780DVD	P II/266	3:43
Transmonde Vivanté XL 2266	P II/266	2:02
Transmonde Vivanté SE 2266	P II/266	3:28
Twinhead Slimnote XL	P MMX/266	3:23
WinBook XLI	P II/266	2:18
VALUE NOTEBOOKS		
Acer Extensa 367D	P MMX/200	3:12
ACT Innomation 5133LE	P MMX/233	1:51
Alcam XL662	P MMX/200	4:19
AMS TravelPro 2500CS	P MMX/233	2:19
ChemBook 3300	P MMX/233	2:30
Compaq Presario 1640	AMD K6/266	3:32
Compaq Armada 1571DM	P MMX/200	3:10
Dell Inspiron 3000 M233XT	P MMX/233	2:53
DFI 6730	P MMX/200	2:02
Digital HighNote Ultra2000	P MMX/266	4:01
DTK FortisPro Top5A233	P MMX/233	2:52
Fosa AP 6100T	P MMX/233	2:20
[illegible]	P II/233	5:01
Hitachi VisionBook Plus 5290	P MMX/266	4:32
HP OmniBook 2100	P MMX/200	3:19
IBM ThinkPad 380XD	P II/266	3:10
Maximus Medianote CD Book	P MMX/200	1:59
MetroBook LT	P MMX/266	4:02
Micron TransPort Trek	P MMX/266	3:09
Mitsuba Dynasty 500	AMD K6/266	1:12
Sharp PC-M200	P MMX/200	2:30
Toshiba Satellite 335CDS	P MMX/266	2:52
Twinhead Slimnote 9TE	P MMX/200	2:52
WinBook XL 233	AMD K6/233	2:29
SUBNOTEBOOKS		
IBM ThinkPad 600	P II/266	3:12
IBM ThinkPad 560X	P MMX/233	3:59
Micron GoBook	P MMX/266	6:33*
NEC Versa SX	P II/266	2:22

BETTER ▶

N/A—Not applicable. The Arm unit could not perform this function.
* Using the standard external battery, with the internal battery only the Micron GoBook scored 1:41

▲ The majority of notebooks use the more efficient, although somewhat more costly lithium ion batteries instead of nickel hydride models (only 5 of 54 tested notebooks used the latter). The long, 6:33 battery life of our top BatteryMark performer, the Micron GoBook, isn't without its price. To get it, you need the unit's thin yet large standard external battery that adds about 2.5 pounds to the unit, raising its travel weight from 5.6 pounds to 8.2 pounds.

BENCHMARK TESTS

Five high-end systems came with DVD drives: the Gateway, IBM, Toshiba, and two Transmonde units. DVD drives are slightly slower than CD-ROM drives—reading CDs at about 11X to 18X—so naturally, these drives had lower scores on our CD-ROM tests. DVD quality varied. On informal testing, we found that the system with the best DVD playback was from Gateway. —*Analysis written by Rich Fisco*

How We Tested

We tested systems in the three categories: high-end, value, and subnotebook. All systems ran Windows 95; high-end units had 64MB of RAM; all others had 32MB of RAM. Before testing, we prepared each system following a standard procedure to create a common state for the testing of all notebooks. We stripped each system's startup configuration of all processes or tasks except for Systray and Explorer. We set the display to the system's maximum internal resolution, 800-by-600 (SVGA) or 1,024-by-768 (XGA) with 65,536 colors and small fonts. We also disabled power management features, defragmented hard disks before each test, and let Windows 95 manage virtual memory settings. Unless otherwise noted in the reviews, we used the vendor's provided graphics driver for all systems.

ZD WINSTONE 98

These tests measure performance on 32-bit Windows applications. Winstone 98 is divided into two parts: **ZD Business Winstone 98**, which focuses on mainstream applications, and **ZD High-End Winstone 98**, which emphasizes CPU and graphics-intensive applications. We ran only our Business Winstone 98 tests, which measure the time a PC takes to execute a set of scripts that exercise nine of the best-selling Windows 95 applications. Business Winstone 98 weights a PC's test timings based on the applications' unit market shares; the test derives a composite number and converts that to a relative score. (The score is relative to the performance of a Dell Dimension Pentium/133 with 32MB of RAM, at XGA resolution with 16-bit color, running Windows NT 4.0 with Service Pack 3. The base score is defined as 10.)

Our **ZD BatteryMark 2.0** test measures a notebook's battery life by exercising three different 32-bit software workload engines, one each for processor, disk, and graphics tasks. BatteryMark mixes these workloads together and adds periodic *think times*, or breaks, that reflect normal user pauses in work. We use standard power management settings during testing: 2 minutes for hard disk time-out (or the closest value available), and Auto or Fast CPU speed. BatteryMark also uses Intel and Microsoft's Advanced Power Management where possible to automate procedures and provide information.

ZD WINBENCH 98

These tests measure a system's graphics, disk, processor, CD-ROM, full-motion video, and DirectDraw performance under Windows 95. **ZD Graphics WinMark 98** and **ZD Disk WinMark 98** are each divided into business and high-end sections. We ran the business portion of these suites.

The **ZD Business Graphics WinMark 98** scores are based on a log of GDI operations used in the Business Winstone 98 test. The scores are normalized to reflect performance relative to the base system used for Winstone testing. The **ZD Business Disk WinMark 98** scores are based on a log of disk functions used in the Business Winstone suite. Results are recorded in thousands of bytes per second, then converted to a harmonic mean. We then weight this mean in the same way we weight the Business Winstone 98 score.

The **CPUmark$_{32}$** test gauges the speed of a PC's processor subsystem, which includes the CPU, secondary cache, and system RAM, under 32-bit operating systems.

The **ZD CD-ROM WinMark 98** test suite gauges the performance of each notebook's CD-ROM subsystem, which includes the CD-ROM drive, adapter, and required software drivers. The tests are based on a profile of today's most popular Windows CD-ROMs. We also report the results of the **CD-ROM Transfer Rate: Inside** test, which measures the

ZD WINBENCH 98

High scores are best.
Bold type denotes first place within each category.
denotes Editors' Choice

	CPU	ZD Business Graphics WinMark 98 Score	ZD Business Disk WinMark 98 Thousands of bytes/sec	ZD CPUmark$_{32}$ Score
HIGH-END NOTEBOOKS				
Alcam XL791	P MMX/266	N/A	825	506
AMS Rodeo 5032ECX	P II/266	105	805	677
ARMNote TS759	P II/266	66	978	692
Brick Ergo BigScreen^4	P MMX/266	73	906	502
Compaq Armada 7800	P II/266	118	1,010	680
Dell Latitude CPi D266XT	P II/266	86	933	670
Digital HiNote VP 765	P II/266	81	889	683
Fosa AP 8600M	P MMX/266	69	772	515
FutureTech FutureMate 6300XL2	P II/266	80	830	687
Gateway Solo 9100LS	P II/266	100	1,050	691
HP OmniBook 7100	P II/266	127	1,050	690
HP OmniBook 4100	P II/266	85	1,090	694
IBM ThinkPad 770ED	P II/266	102	1,080	684
Madmax Powermax XGA CD Book	P MMX/266	59	740	386
Maxtech YesBook X759	P II/266	98	948	699
MetroBook DT	P MMX/266	83	889	513
NEC Versa LX	P II/266	127	956	587
ProGen Venture MMX266	P MMX/266	87	864	501
Quantex H-1331 with PII/266MHz	P II/266	77	938	689
Royal Mobile Pro II	P MMX/266	78	833	471
Sceptre SoundX 5500T	P MMX/266	80	890	504
Toshiba Tecra 780DVD	P II/266	111	1,010	683
Transmonde Vivanté XL 2266	P II/266	75	878	690
Transmonde Vivanté SE 2266	P II/266	86	930	696
Twinhead Slimnote XL	P MMX/266	47	891	499
WinBook XLi	P II/266	103	959	687
VALUE NOTEBOOKS				
Acer Extensa 367D	P MMX/200	45	817	384
ACT Innomation 5133LE	P MMX/233	67	944	401
Alcam XL662	P MMX/200	64	722	431
AMS TravelPro 2500CS	P MMX/233	69	803	382
ChemBook 3300	P MMX/233	59	824	399
Compaq Presario 1640	AMD K6/266	73	883	539
Compaq Armada 1571DM	P MMX/200	71	856	362
Dell Inspiron 3000 M233XT	P MMX/233	75	818	442
DFI 6730	P MMX/200	65	795	404
Digital HiNote Ultra2000	P MMX/266	68	875	470
DTK FortisPro Top5A233	P MMX/233	72	804	410
Fosa AP 6100T	P MMX/233	70	788	374
Gateway Solo 2500SE	P II/233	85	910	682
HP OmniBook 2100	P MMX/200	61	853	400
Hitachi VisionBook Plus 5290	P MMX/266	82	826	430
IBM ThinkPad 380XD	P II/266	105	1,040	682
Maximus Medianote CD Book	P MMX/200	46	743	355
MetroBook LT	P MMX/266	101	850	477
Micron TransPort Trek	P MMX/266	78	852	475
Mitsuba Dynasty 500	AMD K6/266	N/A	836	474
Sharp PC-M200	P MMX/200	N/A	769	367
Toshiba Satellite 335CDS	P MMX/266	96	832	444
Twinhead Slimnote 9TE	P MMX/200	35	698	200
WinBook XL 233	AMD K6/266	61	828	491
SUBNOTEBOOKS				
IBM ThinkPad 600	P II/266	85	910	682
IBM ThinkPad 560X	P MMX/233	66	791	406
Micron GoBook	P MMX/266	93	837	500
NEC Versa SX	P II/266	105	832	680

N/A—Not applicable. This system did not complete the Business Graphics WinMark tests.

◀ The ATI Rage LT Pro powered the top performers; SGRAM and SDRAM use afforded a small boost in the best performers. The majority of notebooks also had 3-D acceleration. Hard disks, however, are a weak point for notebooks. The best disks spin at 4,900 rpm, compared with 7,200 rpm and even 10,000 rpm in desktops. With slower spinning drives, Ultra DMA-33 support was a negligible factor. When it comes to processor subsystem performance, keep in mind that the Intel 440BX chip set found on notebooks doesn't provide you with the 100-MHz system bus that you get on desktops; notebooks still run on a 66-MHz bus. In a field dominated by Intel processors, the two AMD processors performed admirably. They weren't as powerful as the Pentium II processors, but they did outperform the Pentium MMX processors.

▶ With speeds of 20X to 40X (maximum), CD-ROM drives can handle most any need. The best performing among the 24X drives was the Toshiba XM-1702B, which led the field in all categories and was found in 12 of the tested systems. Thanks to faster CPUs and graphics cards, playing video on a notebook is not as painful as it once was. Maximum frame rates above 50 fps are now common, and MPEG-2 hardware decoders and software codecs are also appearing. If you also have a DVD drive, you no longer have to rely on your airline for movies as you travel. Five of the tested notebooks had DVD drives. We tested these DVD drives by viewing DVD movies and looking at specific frames for artifacts, blurriness, and aliasing. We found the Gateway Solo 9100LS performed best. The IBM ThinkPad 770ED and Toshiba Tecra 780DVD were inconsistent. The two Transmonde units were very disappointing, but the company says it is working with its DVD partner to resolve the problems.

MULTIMEDIA TESTS

▲ High scores are best. ▼ Low scores are best.
Bold type denotes first place within each category.
denotes Editors' Choice

		CD-ROM				Full-Screen Scaling*	
	CPU	20 CD-ROM WinMark 98 (thousands of bytes/sec) ▲	Transfer Rate: Inside (thousands of bytes/sec) ▲	Access Time (ms) ▼	CPU Utilization (percent) ▼	Maximum Frame Rate (frames/sec) ▲	CPU Utilization (percent) ▼
HIGH-END NOTEBOOKS							
Alcam XL791	P MMX/266	1,050	1,460	144	36	55.2	59
AMS Rodeo 5632ECX	P II/266	958	1,480	156	61	47.8	67
ARMNote TS750	P II/266	1,400	1,830	107	64	45.8	65
Brick Ergo BigScreen[4]	P MMX/266	1,060	1,820	157	90	45.7	74
Compaq Armada 7800	P II/266	890	1,580	160	61	55.1	59
Dell Latitude CPi D266XT	P II/266	969	1,580	151	6	54.9	60
Digital HiNote VP 765	P II/266	1,320	1,840	152	64	49.1	63
Fosa AP 8800M	P MMX/266	1,120	1,830	154	78	51.5	66
FutureTech FutureMate 6300XL2	P II/266	975	1,460	150	51	48.0	66
Gateway Solo 9100LS	P II/266	984	1,190	115	3	55.2	60
HP OmniBook 7100	P II/266	912	1,830	158	5	50.1	52
HP OmniBook 4100	P II/266	1,410	1,840	106	5	52.6	52
IBM ThinkPad 770ED	P II/266	1,180	1,530	110	4	54.2	70
Maximus Powermax XGA CD Book	P MMX/233	837	1,530	222	64	N/A[2]	N/A[2]
Maxtech YesBook X750	P II/266	1,390	1,820	111	65	46.4	66
MetroBook DT	P MMX/266	1,060	1,740	139	90	45.7	71
NEC Versa LX	P II/266	1,400	1,830	107	64	57.0	57
ProGen Venture MMX266	P MMX/266	947	1,460	149	37	48.9	66
Quantex H-1331 with PII/266MHz	P II/266	1,400	1,840	111	65	52.1	63
Royal Mobile Pro II	P MMX/233	1,060	1,460	136	36	51.4	63
Sceptre SoundX 5500T	P MMX/266	919	1,600	148	13	58.7	56
Toshiba Tecra 780DVD	P II/266	962	1,170	114	42	78.8	91
Transmonde Vivanté XL 2266	P II/266	612	1,160	254	3	55.5	58
Transmonde Vivanté SE 2266	P II/266	975	1,180	100	2	55.3	59
Twinhead Slimnote XL	P MMX/266	956	1,470	148	37	N/A[2]	N/A[2]
WinBook XLi	P II/266	1,080	1,460	131	12	54.1	60
VALUE NOTEBOOKS							
Acer Extensa 367D	P MMX/200	1,060	1,580	161	46	35.3	96
ACT Innomation 5133LE	P MMX/233	963	1,500	157	47	49.7	62
Alcam XL662	P MMX/200	1,050	1,480	142	64	45.2	71
AMS TravelPro 2500CS	P MMX/233	1,150	1,800	164	60	39.8	80
ChemBook 3300	P MMX/233	1,040	1,530	159	39	55.1	76
Compaq Presario 1640	AMD K6/266	1,370	1,840	109	66	43.2	74
Compaq Armada 1571DM	P MMX/200	930	1,620	185	48	43.5	91
Dell Inspiron 3000 M233XT	P MMX/233	1,400	1,840	109	46	51.1	66
DFI 6730	P MMX/200	1,400	1,830	104	38	49.8	65
Digital HiNote Ultra2000	P MMX/266	1,370	1,830	109	64	37.9	66
DTK FortisPro Top5A233	P MMX/233	921	1,530	221	9	49.3	65
Fosa AP 8166T	P MMX/233	1,060	1,840	158	51	40.8	96
Gateway Solo 2500SE	P II/233	729	779	130	2	55.7	58
HP OmniBook 2100	P MMX/200	1,060	1,810	120	9	48.5	65
Hitachi VisionBook Plus 5200	P MMX/266	1,080	1,470	136	37	56.3	69
IBM ThinkPad 380XD	P II/266	1,070	1,810	151	5	54.6	58
Maximus Medianote CD Book	P MMX/200	1,050	1,450	137	49	30.5	96
MetroBook LT	P MMX/266	1,060	1,470	144	37	58.1	58
Micron TransPort Trek	P MMX/266	1,060	1,460	139	37	52.6	62
Mitsuba Dynasty 500	AMD K6/266	1,040	1,820	169	37	N/A[2]	N/A[2]
Sharp PC-M200	P MMX/200	743	1,540	183	24	N/A[2]	N/A[2]
Toshiba Satellite 335CDS	P MMX/266	1,060	1,460	142	49	50.6	72
Twinhead Slimnote 9TE	P MMX/200	904	1,470	156	45	28.2	97
WinBook XL 233	AMD K6/266	1,060	1,470	133	18	44.8	72
SUBNOTEBOOKS							
IBM ThinkPad 600	P II/266	729	779	130	2	55.7	58
IBM ThinkPad 560X	P MMX/233	N/A[1]	N/A[1]	N/A[1]	N/A[1]	56.2	76
Micron GoBook	P MMX/266	1,230	1,910	129	48	54.5	70
NEC Versa SX	P II/266	1,290	1,830	109	64	N/A[2]	N/A[2]

* With an Action MPEG-1, 352-by-240, 30-fps, 300-KBps clip N/A[1]—Not applicable. The IBM ThinkPad 560X did not have a CD-ROM drive
N/A[2]—Not applicable. The Maximus Powermax, Twinhead XL, Mitsuba, Sharp, and NEC SX systems could not complete the Full-Screen Scaling test

throughput of a CD-ROM subsystem reading the inside track of the CD-ROM, the minimal level of performance for the drive. The **CD-ROM Access Time** test measures performance as the drive randomly accesses 2K blocks from the entire CD-ROM. The **CD-ROM CPU Utilization** score represents the percentage of the CPU's bandwidth occupied by servicing the CD-ROM subsystem as it retrieves data.

WinBench 98 also includes a suite of video tests that measure a PC's ability to play full-motion AVI files. These tests run a video clip using an MPEG codec. We tested all systems using MPEG only, through ActiveMovie control. We report results from the **Full-Screen Scaling** test, which uses an Action, MPEG-1, 352-by-240, 30-fps, 300-KBps clip. We report *Maximum Frame Rate* and *CPU Utilization*.

A 56-Kbps PC Card fax modem is bundled with the unit. You also get an illustrated, pocket-size system guide in addition to a book-size manual.

Considering its hardware and price, the ChemBook 3300 is an appealing offering.—*RSA*

Compaq Armada 7800, Armada 1571DM, Presario 1640

Armada 7800: Pentium II/266, 13.3" TFT, 4.8GB disk, 64MB EDO DRAM, 8.6 lbs. Battery: 1:52. Winstone 98: 21. $5,400 street.
Armada 1571DM: Pentium MMX/200, 12.1" DSTN, 3.1GB disk, 32MB EDO DRAM, 7.4 lbs. Battery: 3:10. Winstone 98: 13.4. $2,200 street.
Presario 1640: AMD K6/266, 12.1" TFT, 3.9GB disk, 32MB EDO DRAM, 7.3 lbs. Battery: 3:32. Winstone 98: 15. $2,500 street. Compaq Computer Corp., 800-345-1518, 281-370-0670; www.compaq.com.

● Compaq's high-end Armada 7800 and value Armada 1571DM DMI 2.0–compliant corporate units and its SOHO-oriented value Presario 1640 offer solid features and performance. The Armada 1571DM is worth consideration, but the Armada 7800 doesn't justify its price; the Presario is an adequate system but lacks a USB port. Both Armadas offer built-in modems and integrated AC adapters and their Intelligent Manageability hardware monitor can detect imminent hardware problems, enabling Compaq to replace components before they fail.

The 9-pound (travel weight) Armada 7800 comes with a standard 20X CD-ROM module that can be swapped for a floppy disk drive. You also have the option of using a second battery, a second hard disk, or an LS-120 drive in the modular bay. A DVD drive will soon be available. The 7800's powerful graphics subsystem yielded the top Business Graphics WinMark 98 score in this roundup. Its other scores were average save for a below-average CD-ROM WinMark result and a poor time of 1:52 on our battery test, despite a lithium ion battery. Another problem: The system has a pointing stick but lacks a palm rest.

The Armada 1571DM has a travel weight of 7.9 pounds and comes with a fast 12.1-inch dual-scan SVGA display, a floppy disk drive that swaps for a second lithium ion battery, and a fixed 20X CD-ROM drive. The 1571DM posted a strong average score on our Graphics WinMark tests. Its other test results were also average. The unit had a better-than-average time of 3:10 on our battery test.

The Presario 1640, one of three AMD K6–based units reviewed here, offers a 12.1-inch TFT SVGA display. It has a travel weight of 8.1 pounds and comes with a fixed 24X CD-ROM drive. Its lithium ion battery lasted 3:32 on our BatteryMark test. Unlike the two Armada models, the Presario lacks IR and USB ports—the latter being the more serious omission, given the growing number of USB peripherals and the fact that the unit is aimed at home users. It was one of only four units in our roundup that lacked a USB port. The unit does offer multimedia features, such as external CD-ROM control buttons and large stereo speakers. The unit's Business Winstone 98 score places it roughly between the reviewed Pentium MMX/200 and Pentium MMX/233 units. Its Business Disk WinMark 98 score was below average, but its CD-ROM WinMark 98 score was one of the best in this roundup.—*RSA*

Dell Latitude CPi D266XT

Dell Latitude CPi D266XT, Inspiron 3000 M233XT

Latitude CPi D266XT: Pentium II/266, 13.1" TFT, 4GB disk, 64MB EDO DRAM, 6.5 lbs. Battery: 3:03. Winstone 98: 18.6. $3,299 direct.
Inspiron 3000 M233XT: Pentium MMX/233, 13.3" TFT, 2GB disk, 32MB SDRAM, 6.8 lbs. Battery: 2:53. Winstone 98: 14.8. $2,099 direct. Dell Computer Corp., 800-388-8542, 512-338-4400; www.dell.com. 509 at www.pcmag.com/infolink.

● Dell Computer Corp. offers corporate users a solid array of features in its high-end Latitude CPi D266XT and value Inspiron 3000 M233XT notebooks, meant for budget-conscious small-office and home users. The Inspiron was a strong performer for its class, while the Latitude lagged behind its competition on several benchmark tests.

The slim (1.6 inches) Latitude came with a 13.3-inch TFT XGA display that can switch to full-screen SVGA mode, but with eye-straining results. The unit also comes with Dell OpenManage system management software and supports wake-on-modem-ring (similar to IBM's and Intel's Wake on LAN technology, but for modems). The front-mounted 20X CD-ROM drive module swaps for a floppy disk drive—which can also be used externally—or a second battery ($169). Featuring a travel weight of just 7.4 pounds, the unit posted a good time of 3:03 on our BatteryMark test, using a lithium ion battery. To facilitate the lives of corporate customers, Dell offers standardized peripherals that can be shared among all Latitude units, and all Latitudes are DMI 2.0–compliant. Our tested unit came with an optional $149 56-Kbps x2 PC Card modem.

The Inspiron unit uses a 13.1-inch TFT XGA display, comes in a slightly thicker (2-inch) box than the Latitude, and has a travel weight of 8.1 pounds. Its side-mounted 24X CD-ROM drive swaps for a floppy disk drive or a second battery; a DVD drive is available for $299. The system came with generous online help, a foldout setup guide, an illustrated manual, and Microsoft Office 97 Small Business Edition. Using a lithium ion battery, the unit lasted 2:53 on our BatteryMark test, a good result.

The Inspiron was an above-average

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- PC Magazine

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"The TransPort Trek is the Fastest Budget Notebook We've Run Through Our Mill."**

- PC World, *Ranked #1, April '98*

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"MICRON TRANSPORT TREK - RANKED #1 BUDGET NOTEBOOK BY PC WORLD"**

PC World, "Best Buy," May '98

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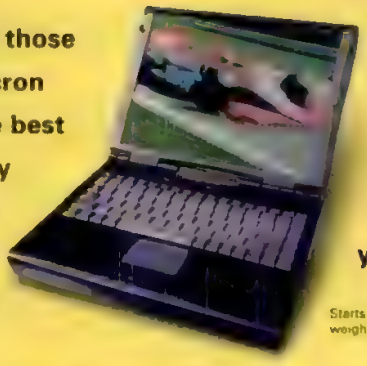

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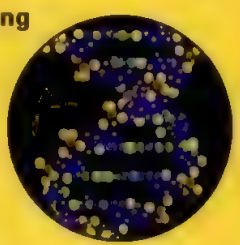

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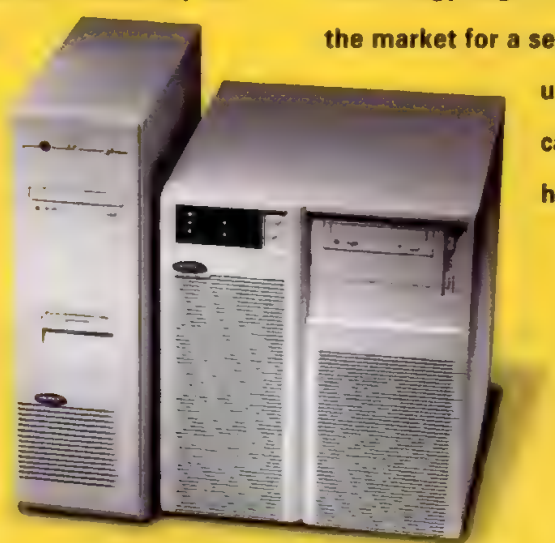

"Micron's Dual-Processor...Server Runs Full Steam Ahead."
- PC Computing

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performer for its class for the most part, save for average scores on our Winstone and disk tests. The Latitude unit posted average scores on our Winstone and CPU tests, but had below-average results on our remaining tests.

Dell was one of two laptop vendors to earn top scores across our Service and Reliability reader survey (the other was Gateway). Dell backs the Latitude with a three-year-parts, one-year-labor warranty, while the Inspiron comes with a one-year plan.—*RSA*

DFI 6730

Pentium MMX/200, 13.1" TFT, 2GB disk, 32MB EDO DRAM, 7.8 lbs. Battery: 2:02. Winstone 98: 15.1. $2,100 street. DFI, 800-334-1196, 510-657-5678; www.dfi.net. 510 at www.pcmag.com/infolink.

● If the fastest performance isn't important to you, but you want to buy a notebook as an alternative to having different PCs at the office and at home, you're the right fit for DFI's value-class DFI 6730. Better-than-average performance for its class, a 13.3-inch XGA active-matrix screen, and about $1,000 of savings compared with high-end Pentium II laptops take away some of the sting of CPU-envy.

With a moderate travel weight of 8.6 pounds, the DFI 6730 isn't a tiny package, but its three-spindle design means you won't have to tote an extra drive in your carry-on bag. The lithium ion battery produced a relatively low 2:02 BatteryMark result, so you might consider buying an extra battery ($199).

A good CPU score and an above-average Business Graphics WinMark 98 result, thanks to the S3 ViRGE/MX graphics chip set with 4MB of SGRAM, led the DFI 6730 to a strong Business Winstone 98 score, compared with other systems in the value category. Its CD-ROM score was above average; the unit's other scores were average.

Adding memory to the 6730 isn't tough but requires taking the case apart a bit. Hard disk swaps, on the other hand, are quick and easy: The disk slides right out of its bay.

A one-year parts-and-labor warranty is boosted by a three-dead-pixel policy and a 72-hour guaranteed turnaround on parts replacement policy. The DFI 6730 is a good buy for those who are looking for moderate performance at a reasonable price.—*BB*

DFI 6730

Digital HiNote VP 765, HiNote Ultra2000 GTX 5266M

HiNote VP 765: Pentium II/266, 13.1" TFT, 4GB disk, 64MB SDRAM, 7.5 lbs. Battery: 2:42. Winstone 98: 18.8. $3,300 street.
HiNote Ultra2000 GTX 5266M: Pentium MMX/266, 14.1" TFT, 3.9GB disk, 32MB EDO DRAM, 6.7 lbs. Battery: 4:01. Winstone 98: 14.7. $4,000 street. Digital Equipment Corp., 800-344-4825, 978-493-5111; www.windows.digital.com. 511 at pcmag.com/infolink.

● Although both notebook offerings from Digital are marketed as high-end systems, the company chose to send the Ultra2000 GTX 5266M configured for this roundup's value category. Overpriced for this category, the Ultra2000 targets the professional seeking a lightweight system to power multimedia presentations and demanding business applications; its features should suit those users. Digital positions the VP 765 roughly the same way but aims the unit toward those seeking a lower-priced reliable workhorse. Both systems are DMI 2.0-compliant.

Of the two, the VP 765 was the stronger performer on our benchmark tests, posting one of the top Winstone and CD-ROM WinMark scores for its high-end group. The Ultra2000 was no slouch either, earning mostly average scores for its class and an above-average CD-ROM result.

The Ultra2000's 1.4-inch thickness, 7.3-pound travel weight, brilliant 14.1-inch display with 24-bit, XGA resolution, combination internal 56-Kbps modem and 10/100 Ethernet network adapter, and Digital's ClientWorks management software make it stand out. The unit also boasts 1MB of L2 cache, which can help CPU subsystem performance. This two-spindle system comes with swappable CD-ROM and floppy disk drives; the latter can be used externally. With a lift of the keyboard, you can access the hard disk for upgrades. Using a lithium ion battery, the unit lasted an impressive 4:01 on our battery test. But unlike most other notebooks in this roundup, the Ultra2000 lacks a USB port.

The VP 765 has two USB ports and accommodates three spindles. Its combination CD-ROM/floppy disk drive module pops right out and can be replaced with a second battery. Remove just one screw and the hard disk slides out the side. Unlike the Ultra2000, the VP 765 features a SMART lithium ion battery. Like the Ultra2000, the VP 765 offers ClientWorks. The system lasted 2:42 on our battery test.

The VP 765 is a solid high-end system with a good balance of price and features. The Ultra2000 should appeal to those who want a thin and fairly light notebook for presentations.—*Angela Tuka*

DTK FortisPro Top5A233

Pentium MMX/233, 12.1" TFT, 2.9GB disk, 32MB EDO DRAM, 7.1 lbs. Battery: 2:52. Winstone: 14.8. $1,950 street. DTK Computer Inc., 800-289-2385, 626-810-0098; www.dtk-computer.com. 512 at www.pcmag.com/infolink.

● Sold predominantly into government and educational environments as well as to corporate/business travelers, the FortisPro Top5A233 has a few flaws. But for under $2,000, the system is reasonably portable and boasts a fair battery life.

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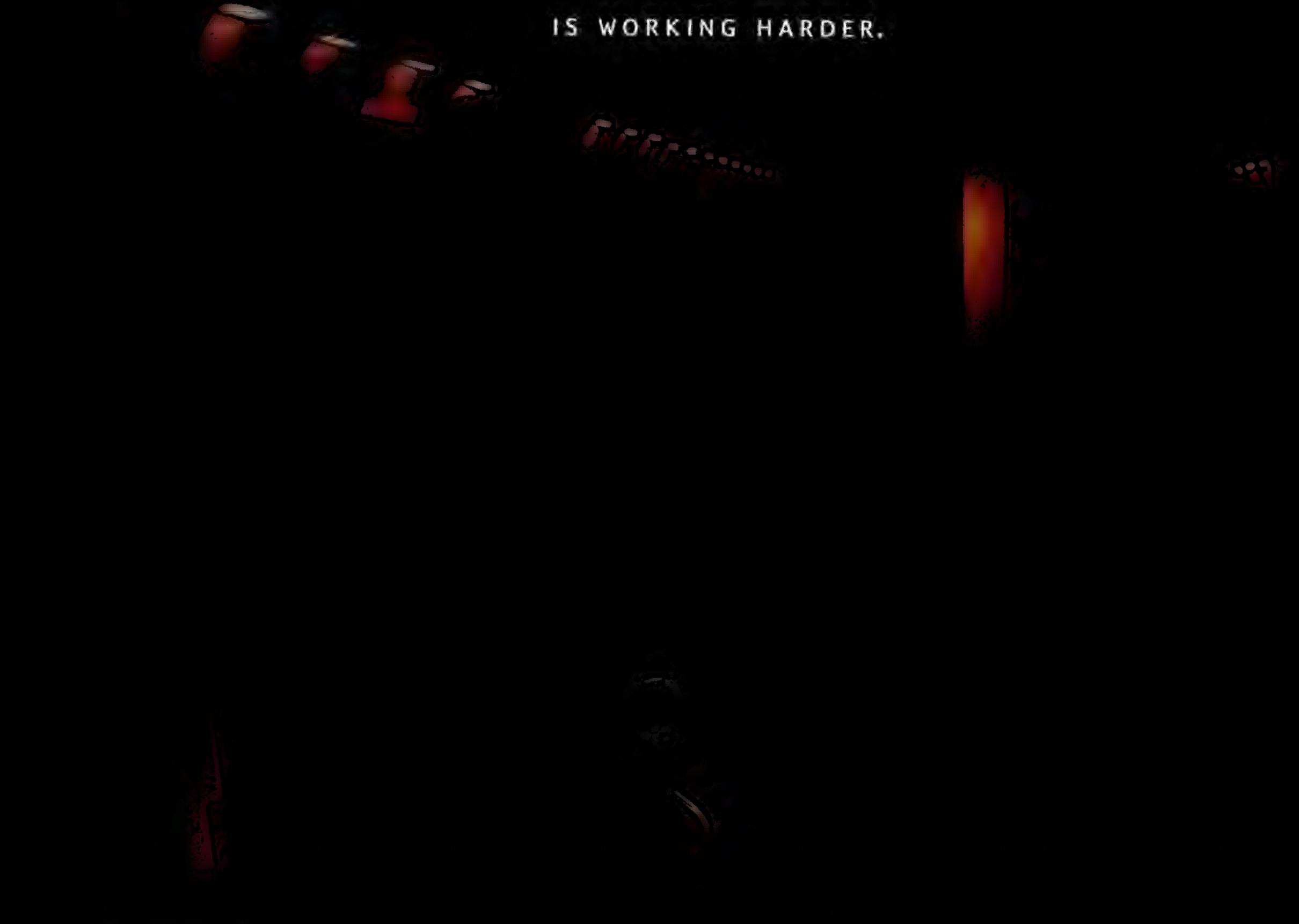

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Expanding Possibilities

This ebony black system, weighing only 7.8 pounds with an AC adapter, has a single modular bay that holds a floppy disk drive, a CD-ROM drive, or an optional SMART second lithium ion battery ($120). You can use the 0.6-pound floppy disk drive as an external device. Other system options, such as a DVD module, must be purchased separately from a third party.

The system's keyboard is quiet and responsive. The touch pad, however, is placed in the center of a deep palm rest rather than directly beneath the Spacebar (which would be better for touch typing) and a pair of unusually stiff mouse buttons made double-clicking—and occasionally single-clicking—difficult.

Though most of the system's port covers are hinged and easily broken, the door to its docking station port retracts into the machine. This and its external volume control wheel are the unit's most-desirable features. The FortisPro had a below-average score for its class on our CD-ROM WinMark 98 but posted average scores on other tests.

DTK offers a two-year warranty with the unit and guarantees a 48-hour turnaround for parts replacement. If you can live with a few hardware problems, the FortisPro offers good battery life and a low price.—*CM*

Fosa AP 8800M, AP 6100T

AP 8800M: Pentium/MMX 266, 15.1" TFT, 3.9GB disk, 64MB SDRAM, 10.1 lbs. Battery: 2:38. Winstone: 16.7. $3,700 street.
AP 6100T: Pentium/MMX 233, 12.1" TFT, 3.1GB disk, 32MB SDRAM, 7.5 lbs. Battery: 2:20. Winstone: 13.0. $1,800 street. Fosa Computer Inc., 800-216-3672, 908-753-6100; www.fosa.com. 513 at www.pcmag.com/infolink.

● Desktop replacement is a familiar term in the notebook market, but few portables can truly replace a desktop. The Fosa AP 8800M comes closer than most models, integrating a 15.1-inch display and a full numeric keypad. Though nearly $800 cheaper, it is almost identical to the MetroBook DT (also reviewed). The AP 8800M is designed for engineers, architects, and other high-end users; they'll be satisfied with the unit's screen, but they might prefer a Pentium II–based unit. Fosa's value offering, the Fosa AP 6100T, is sold to budget-minded mobile users and offers the convenience of three simultaneous drives. Fosa sells its notebooks direct and through resellers.

The AP 8800M's CD-ROM drive, floppy disk drive, and hard disk are all easily removed. The floppy disk drive can be replaced with a Zip Drive ($210) or a second hard disk, while the CD-ROM drive can be swapped for a DVD drive ($250). If you enable the Zip Drive, however, you cannot—for reasons unknown to us—use Windows 95's Restart feature.

The machine was a poor performer for its class on the Disk WinMark tests, but its Graphics WinMark performance was well above-average. With a travel weight of 11.3 pounds, the AP 8800M is not for lengthy trips; its size also prevents it from fitting into a standard carrying case.

The AP 6100T (with an 8.7-pound travel weight), has an integrated CD-ROM drive and one modular bay that can house a floppy disk drive or an optional second battery. The machine lacks USB ports and CardBus support. A touch pad is centered in the palm rest instead of below the Spacebar. Performance was average for its class.

Both units have fewer OS-based power management features than the typical laptop. The AP 8800M offers a large screen and excellent graphics performance; the AP 6100T is a serviceable value unit.—*CM*

FutureTech FutureMate 6300XL2

FutureTech FutureMate 6300XL2

Pentium II/266, 13.3" TFT, 3.9GB disk, 64MB SDRAM, 8.5 lbs. Battery: 4:02. Winstone 98: 18.5. $3,000 street. FutureTech Systems Inc., 800-275-4414, 201-488-4414; www.futuretec.com. 514 at www.pcmag.com/infolink.

● Targeted at sales professionals and corporate executives who need a combination of good battery life and high performance, the FutureTech FutureMate 6300XL2 is a solid, fair buy at its $3,000 street price. Wringing more than 4 hours of battery life from its lithium ion battery, the two-spindle FutureMate combines good overall performance with several design features that stress convenience and sturdy construction.

The 6300XL2 has a keyboard that tilts up automatically when you raise the screen lid. A pointing stick is in the middle of the keyboard; the stick's buttons are a little off-center, but not by much. Memory and hard disk changes require a screwdriver, but access is clear. You can warm-swap batteries when the system is in suspend mode, so an extra battery ($199) can keep you working for an entire 8-hour day away from AC power. The floppy disk drive can be swapped for a CD-ROM drive or other modules such as a DVD ($265) or Zip Drive ($285). The floppy disk drive can also be used externally. Other options include a 56K PC Card modem ($149) and a port replicator ($265).

Most of the 6300XL2's test scores were average, with two exceptions. The unit's Business Disk WinMark 98 score was just below the average range for its class because of a relatively slow 4,800-rpm Toshiba hard disk, and its Toshiba CD-ROM drive produced a low CD-ROM WinMark 98 score.

Despite a travel weight of 9.2 pounds, this rugged, tightly constructed notebook is a fine workhorse for demanding mobile workers.—*BB*

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Gateway Solo 9100LS, Solo 2500SE

Solo 9100LS: Pentium II/266, 14.1" TFT, 4.8GB disk, 64MB SDRAM, 8.8 lbs. Battery: 2:52. Winstone 98: 19.9. $3,849 direct.
Solo 2500SE: Pentium II/233, 12.1" TFT, 2GB disk, 32MB SDRAM, 6.9 lbs. Battery: 5:01. Winstone 98: 17.7. $2,149 direct. Gateway, 800-846-2000, 605-232-2000; www.gateway.com. 515 at www.pcmag.com/infolink.

Gateway Solo 9100LS and 2500SE

PC MAGAZINE EDITORS' CHOICE

Gateway aims the high-end Solo 9100LS toward users who want the best of both worlds: the performance of a desktop and the flexibility of a mobile PC. The value-oriented Solo 2500SE is meant for those who want the best blend of power and a reasonable price. Both units are DMI 2.0-compliant and make great additions to any business. Both earned Editors' Choice.

With a travel weight of 9.7 pounds, the 9100 LS is one of the heavier units we tested. It comes with a combination DVD drive/floppy disk drive module, which can be swapped for a second lithium ion battery ($200). A CD-ROM drive/floppy disk drive combination is a $400 option. The 9100LS's DVD drive offers a clear, flicker-free picture; to take advantage of the Dolby Stereo Surround Sound, you can use the included headphones or attach a pair of Boston Acoustic MicroMedia Speakers ($149). The unit's disk is easy to remove for upgrades, travel, or security.

Using its lithium ion battery, the unit did very well on our battery test, lasting nearly 3 hours. Most other test scores were average or above average.

The 9100LS bundles some nice extras, including Microsoft Bookshelf 98, and Microsoft Office 97 Small Business Edition. It also offers an optional auto/airline adapter and a cellular-capable 56K PC Card modem.

The Solo 2500SE is the only Pentium II/233–based unit in this roundup and one of only two mobile Pentium IIs in the value notebook category; accordingly, this unit's performance was average to above average within its class. The system really stands out as a road warrior, however. It has a 7.7-pound travel weight, lets you warm-swap the battery, and has SMART battery technology for keeping track of remaining battery life. Even better: Using a lithium ion battery, the unit lasted an amazing 5:01 on our BatteryMark test. The 2500SE is a three-spindle machine: Its hard disk and floppy disk drive slide out after you remove one screw; the CD-ROM drive, however, is not removable.

Gateway earned top scores across our Reader Service and Reliability survey. Both machines meet the needs of their target audiences well, and the Solo 2500SE has the makings of a good road warrior system.—*Angela Tuka*

HP OmniBook 7100, OmniBook 4100, OmniBook 2100

OmniBook 7100: Pentium II/266, 14.1" TFT, 7.8GB disk, 64MB SDRAM, 8.7 lbs. Battery: 3:32. Winstone 98: 20.3. $5,180 street.
OmniBook 4100: Pentium II/266, 14.1" TFT, 6.1GB disk, 64MB SDRAM, 6.7 lbs. Battery: 3:01. Winstone 98: 19.4. $4,550 street.
OmniBook 2100: Pentium MMX/200, 12.1" DSTN, 2GB disk, 32MB EDO DRAM, 6.6 lbs. Battery: 3:19. Winstone 98: 14.8. $1,530 street. Hewlett-Packard Co., 800-752-0900, 970-635-1000; www.hp.com/omnibook. 516 at www.pcmag.com/infolink.

● IBM ThinkPads aside, no notebook family blankets today's highly fragmented market as well as Hewlett-Packard's OmniBook series. HP offers a serviceable value machine (the HP OmniBook 2100); a 1.4-inch-thick, two-spindle, high-end subnotebook (the HP OmniBook 4100); a hefty desktop replacement (the HP OmniBook 7100); and a modest midrange system (the HP OmniBook 3100—not reviewed here—which uses the same case as the 2100). HP also markets an ultralight unit, the 0.7-inch-thick OmniBook Sojourn, which weighs 3.2 pounds. HP's OmniBooks are all DMI 2.0-compliant.

The 7100 and 4100 offer pointing sticks that, in tandem with their touch pads, are always operational. All three use lithium ion batteries and lasted more than 3 hours on our test.

The 4100 is heavier (7.6 pounds with an AC adapter) and thicker (1.6 inches) than IBM's ThinkPad 600, but it affords dual pointing devices, retractable port and PC Card doors, and a versatile drive bay. The drive bay normally houses a floppy disk or CD-ROM drive but can also accommodate other options: an LS-120 drive ($129), a DVD drive ($289), or later this year, a Zip Drive or second hard disk. Though the machine's display is lucid and unusually vivid, its Graphics WinMark score was below average. The unit's Disk and CD-ROM WinMark scores, however, were above average. Other scores were average.

Weighing 9.5 pounds (travel weight), the 7100 isn't nearly as portable as its siblings, but it has a three-spindle design. A front modular bay holds a combination CD-ROM/floppy disk drive but can also hold an LS-120 drive ($129) and will soon accommodate DVD, Zip, and second hard disk drives. Though its mouse buttons are wide enough at the base for comfortable usage with the touch pad, they are thin at the top, causing difficulties when used with the 7100's pointing stick. The unit produced an average Winstone score and above-average graphics and disk scores.

Priced, remarkably, below $1,600, the 2100 has a good travel weight (7.4 pounds). Its single modular bay can house either a standard CD-ROM drive or a floppy disk drive but can also accommodate an optional Zip Drive ($250). Compatible DVD and secondary hard disks will be available later

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For instance, to create winning proposals over and over again, you want your customer's plans and the history of your relationship at your fingertips. We're not only talking volume, credit history, and the bottom line, but also the interpersonal relationship-the nuances of how you have worked together.

Technologically, both the top-down planning and the individual interaction require a customer database: an information file on your customers and their accounts — the notes, the phone discussion logs, the presentations and proposals.

As your company grows, software tools can help you maintain the professionalism and personal touch you've been known for, reminding you and your staff about important customer dates and events — from appointments and scheduled services or product updates to birthdays and anniversaries.

Responsiveness

Responsiveness on a day-to-day basis says you provide customers with the answers they need when they need them. That can translate into a variety of things. For instance, for the sales and service people, instant access to customer records is vital. A user-friendly database, one your staff can query easily, is the first need. But access can also be speeded by technology that, for instance, enables caller ID to bring up the record before the sales or service person says "good morning."

It doesn't matter what information your customer needs and how fast, there's a communication vehicle for getting it there and you have to use it all: email, voice mail, fax, overnight delivery. For instance, computer-to-fax is the fastest way to get your customers hard copy, whether they are in their office, hotel room, or car. We're talking about documents you send from your computer that might contain a just-assembled combination of the latest promotions, product illustrations, and — from the customer database — the customer's current product configuration.

Productivity

Being able to provide your customers with better products and ever higher levels of service, being

able to develop and retain close relationships with individual customers as your customer base grows — all this carries a cost to your business. You can't stay customer-driven as we've described if your resources are strained and your bottom line suffers.

The technology solutions we've noted above — the customer and prospect database, word processor, email messaging and other communications tools such as computer-to-fax, and the calendar — are also crucial productivity tools for your organization, allowing them to be responsive to customers literally at the push of a button.

To improve ease-of-use, while safeguarding your investment in new and older computing equipment, such tools must all operate on all major computing platforms.

These tools are win-win solutions for the front lines of your business — the people who plan and deliver what the customer needs. You also need technology that protects your business and your customer's, and solutions exist for your back office to provide these safeguards.

Protection

Flash...computers are vulnerable and fallible. They crash, wiping out that 10-page proposal you hadn't saved. They can get viruses. Installing new programs can mess up your system. Worse, you can wipe out data on your customer. And, electronically connected to your customers, you can send them a virus that wreaks havoc on their systems.

The good news is that technology solutions exist to fend off these problems.

Small Business Solutions

• ACT!™ is the complete customer and calendar management software that turns contacts into relationships and relationships into results. It provides instant access to critical customer and calendar information. Onscreen alarms remind you of important customer dates and activities. Built-in network support and remote two-way data synchronization let you share information across your entire team. Internet links and email support right from the ACT! desktop.

• WinFax PRO!™ gives you hassle-free faxing right from your computer. Wherever you are, you can send professional-quality faxes from your computer, including from your ACT! database, to individual customers or a group of customers. To save money, you can also schedule faxes for off-peak hours.

• Norton AntiVirus eliminates today's viruses and tomorrow's new ones. Given that companies are increasingly communicating electronically with their customers and in danger of transmitting viruses, Norton AntiVirus is the best protection for both your business and your customers. PC Magazine, in giving this product the Editor's Choice award this year, called it "the best combination of virus protection, performance, and usability." Such leading publications, as well as leading laboratories, confirm that it provides 100% detection of "in the wild" viruses from all potential sources — the Internet, intranet and other networks, floppy disks, email attachments and shared files. It also provides 100% disinfection of Word Macro viruses.

• Norton Utilities™ provides unrivaled problem-solving power and control by detecting, repairing, and interpreting most computer problems. A trusted solution for more than 15 years, Norton Utilities continuously monitors and maintains your system so you don't have to guess which utility to launch when there's a problem. Worried about crashes and disaster-recovery downtime? As PC Magazine has stated, Norton Utilities is "the industry leader" in protecting against crashes — more times an effective as any competing product — and provides advanced disaster recovery capabilities to bring your system back up quickly.

• Norton Uninstall™ Deluxe is another solution for protecting your data. Used to move or remove programs and files, it keeps shared files in tact and maintains system settings for programs that are moved or copied. Compressed backups for every deletion are automatically saved, so you can always retrieve what you've just discarded. The UnInstaller™ feature lets you test drive new programs. If a new piece of software causes conflicts, just press a button, and you'll automatically return to the way it was. Norton Uninstall Deluxe can also automatically clean up your hard drive when you boot your personal computer.

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in the year. With a NeoMagic chip set, the 2100 had above-average graphics scores; its other scores were average.

All three OmniBooks offer SmartCard Security ($175), which plugs into a PC Card slot and can be used to lock your machine and encrypt data.—*CM*

Hitachi VisionBook Plus 5290

Pentium MMX/266, 12.1" HPA, 3GB disk, 32MB EDO DRAM, 7.0 lbs. Battery: 4:32. Winstone 98: 15.5. $2,300 street. Hitachi PC Corp., 800-555-6820, 408-546-8000; www.hitachipc.com. 517 at www.pcmag.com/infolink.

● If long battery life and a good feature set matter to you but you can't stretch your budget, check out the Hitachi VisionBook Plus 5290. Hitachi also offers a corporate notebook line, VisionBook Pro; these units come with Pentium II CPUs and 10/100 Ethernet network adapters.

The Hitachi's 12.1-inch SVGA High Performance Addressing (HPA) screen is a major contributor to the unit's low price and long battery life (4:32 on our test with a nickel hydride battery). But this display technology, which strikes a midpoint between TFT and conventional line-scan passive-matrix technologies, comes at somewhat of a cost to brightness and clarity.

With a 8.6-pound travel weight, the 5290's heft is about average for this class. The two-spindle design is well done, with no port covers to fall off. You can swap the floppy disk drive and the CD-ROM drive, and an LS-120 drive module is a $199 option. Hitachi claims you can warm-swap the battery with the system in suspend mode. A mini-dock costs $299 street.

In benchmark testing, most of the system's scores were in the average range for its class. The unit's CPUmark$_{32}$ test result, however, was below average, because the system had a 256K L2 cache in a field where most have 512K.

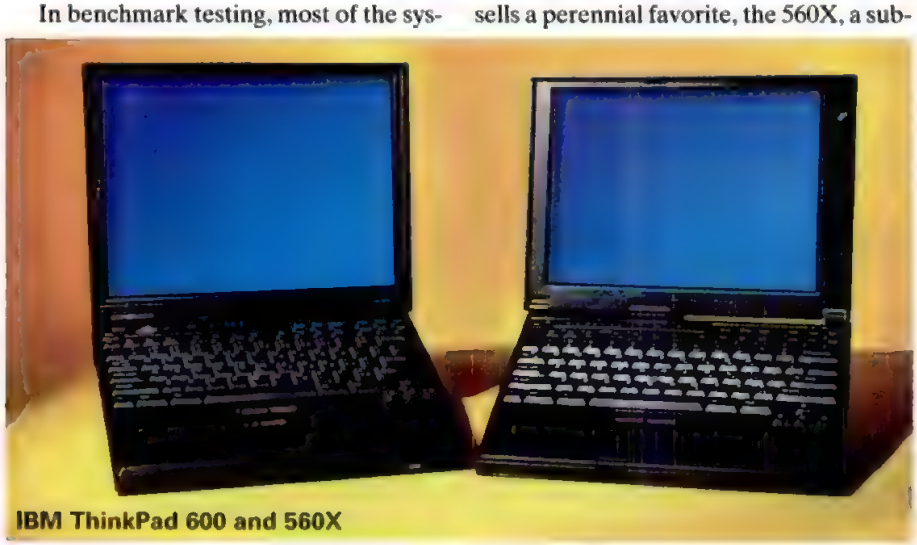
The major compromise is the 5290's screen, but it's good enough that some users may mistake it for active matrix. If you don't need the very high end, the VisionBook Plus 5290's battery life and low cost will put time on your side and keep money in your pocket.—*BB*

IBM ThinkPad 770ED, 380XD, 600, 560X

ThinkPad 770ED: Pentium II/266, 14.1" TFT, 7.8GB disk, 64MB EDO DRAM, 8.1 lbs. Battery: 3:52. Winstone: 20.1. $5,800 street.
ThinkPad 380XD: Pentium II/266, 12.1" TFT, 4.8GB disk, 32MB EDO DRAM, 7.0 lbs. Battery: 3:10. Winstone: 19.3. $3,900 street.
ThinkPad 600: Pentium II/266, 13.3" TFT, 3.9GB disk, 32MB SDRAM, 5.5 lbs. Battery: 3:12. Winstone: 17.8. $4,600 street.
ThinkPad 560X: Pentium MMX/233, 12.1" TFT, 2.0GB disk, 32MB EDO DRAM, 4.1 lbs. Battery: 3:59. Winstone: 15.1. $3,100 street. IBM Corp., 800-426-2968, 914-766-1900; www.ibm.com/thinkpad. 518 at www.pcmag.com/infolink.

PC MAGAZINE EDITORS' CHOICE

As usual, IBM notebook hardware is leading the industry. Each of these ThinkPad systems offers a strong feature set. The 770ED is a large—and expensive—desktop replacement designed for leading-edge performance. The 380XD is a mainstream three-spindle machine sold through value-added resellers (similar to the 385, available through retail stores). The 600, which wins an Editors' Choice, is the first subnotebook to offer a modular bay. Along with this trio, the company still sells a perennial favorite, the 560X, a subnotebook with a travel weight of just over 5 pounds and again one of our Editors' Choice winners.


IBM ThinkPad 600 and 560X

With a travel weight of 9 pounds, a thickness of 2.3 inches, and only two spindles, the 770ED may not be the frequent traveler's first choice. You can use the 0.8-pound floppy disk drive externally if the modular bay is occupied with the DVD or CD-ROM module. The unit's DVD implementation was good, but we noticed some artifacts left behind onscreen. IBM's DVD software interface was also deficient, lacking chapter, scene, and minute readouts. You benefit from an external volume control, easily accessible components, and above-average disk performance.

Though not value priced, now that it integrates both a floppy disk and a CD-ROM drive, the 380XD is an attractive mainstream portable. With a 11.6-by-8.9 footprint (WD) and an 8-pound travel weight, it's among the most portable three-spindle machines on the market. You can't swap its stacked floppy disk and CD-ROM drives for other high-end hardware, but the 380XD offers external volume control, retractable doors on its PC Card bay, and above-average disk performance. Lower-cost 380XD models come with Pentium MMX/233 CPUs, priced around $2,699.

The 600 offers a very good compromise between features and portability. The 600 has a travel weighs of but 6.5 pounds and a good battery life, at 3:12. You can swap the floppy disk drive for the CD-ROM or use the drive externally. The machine's unique, rubberized component covers are strong enough to use to pick the unit up. Performance was uneven: The 600 had below-average scores on our graphics and CD-ROM tests but average scores elsewhere.

Though the 560X will not come with a Pentium II CPU until later this year, it still fills a valid niche in the market. It lacks an internal floppy disk drive or a CD-ROM drive but weighs only 5 pounds with its AC adapter. And the 560X lasted nearly 4 hours on our battery test, making it ideal for true road warriors. The unit earned above-average Graphics WinMark scores; other scores were average.

Each of these machines offers extensive OS-based power management and system configuration utilities; brilliant, lucid displays; and Lotus Smart Suite.—*CM*

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Maximus Powermax XGA CD Book, Medianote CD Book

Powermax: Pentium MMX/233, 13.3" TFT, 3.9GB disk, 64MB SDRAM, 7.7 lbs. Battery: 1:12. Winstone 98: 12.2. $2,499 direct.
Medianote: Pentium MMX/200, 12.1" DSTN, 2.1GB disk, 32MB EDO RAM, 7.3 lbs. Battery: 1:32. Winstone 98: 10.8. $1,499 direct. Maximus Computers Inc., 800-888-6294, 626-815-7777; www.maximuspc.com. 519 at www.pcmag.com/infolink.

● The two Maximus Computers notebooks—the high-end Powermax XGA CD Book and the value-class Medianote CD Book—offer solid hardware features, but their battery life and performance were disappointing.

The Powermax, which has a travel weight of 8.4 pounds, comes in a rubberized case with a suedelike feel. The unit has a 13.3-inch TFT XGA display and offers generous connectivity options, including two USB ports, an S-Video port, a MIDI port, and a docking-station connector. In the Powermax's three-spindle system, the floppy disk drive and 24X CD-ROM drive are fixed, but the hard disk is easy to remove for upgrades, travel, or security.

Unfortunately, the unit's lithium ion battery posted one of the worst battery times in this roundup, lasting just 1:12 on our BatteryMark test. On our other benchmark tests, the Powermax also garnered below-average scores for its class.

The Medianote has a 12.1-inch dual-scan SVGA display and a fixed 20X CD-ROM drive and floppy disk drive, plus a rear Fast IR port and a front IR port for use with a wireless mouse or any IR-enabled device. Unlike the Powermax, the unit lacks a USB port or docking station connector.

The Medianote, which weighs 8.4 pounds (travel weight), uses a nickel hydride battery that lasted a poor 1:32 on out BatteryMark test. The unit logged below-average scores on our Business Winstone 98 and Business Graphics WinMark 98 tests and average scores on remaining tests.

Both of the units come with Lotus SmartSuite 97 and are backed by a one-year warranty. Poor battery life and performance suggest you can find better values elsewhere.—*RSA*

MaxTech YesBook X759

Pentium II/266, 14.1" TFT, 4.9GB disk, 64MB SDRAM, 8.4 lbs. Battery: 3:02. Winstone 98: 18.5. $3,200 street. MaxTech Corp., 800-289-4821, 562-921-1698; www.maxcorp.com. 520 at www.pcmag.com/infolink.

● If you're looking for a good business desktop replacement, you may want to check out the high-end MaxTechYesBook X759. The unit earned average results on most of our tests and comes at a reasonable price.

Complementing good performance, the YesBook offers all the necessary ports and jacks, including a PC Card bay and two USB ports. The YesBook has a large, clear LCD screen, a comfortable keyboard with full-size keys, an ergonomic touch pad, a wrist rest, a microphone, and integrated speakers. The unit is one of the few with a good software bundle: Microsoft Office 97 Professional. Most other systems come with basic utilities only.

After you move a locking tab, the CD-ROM, floppy disk drive, and battery slide out so you can upgrade or replace the components. A $250 DVD module can replace the CD-ROM; you can also slip in a second battery (either lithium ion or nickel hydride). To upgrade either the hard disk or memory, simply remove one screw.

MaxTech YesBook X759

The YesBook's 9.2-pound travel weight is a bit high if you travel constantly, and its lithium ion battery lasted 2:30 hours on our battery test—not great but not too bad for its class. All other test scores were average save an above-average CD-ROM WinMark 98 result, thanks to a Toshiba 24X CD-ROM drive.

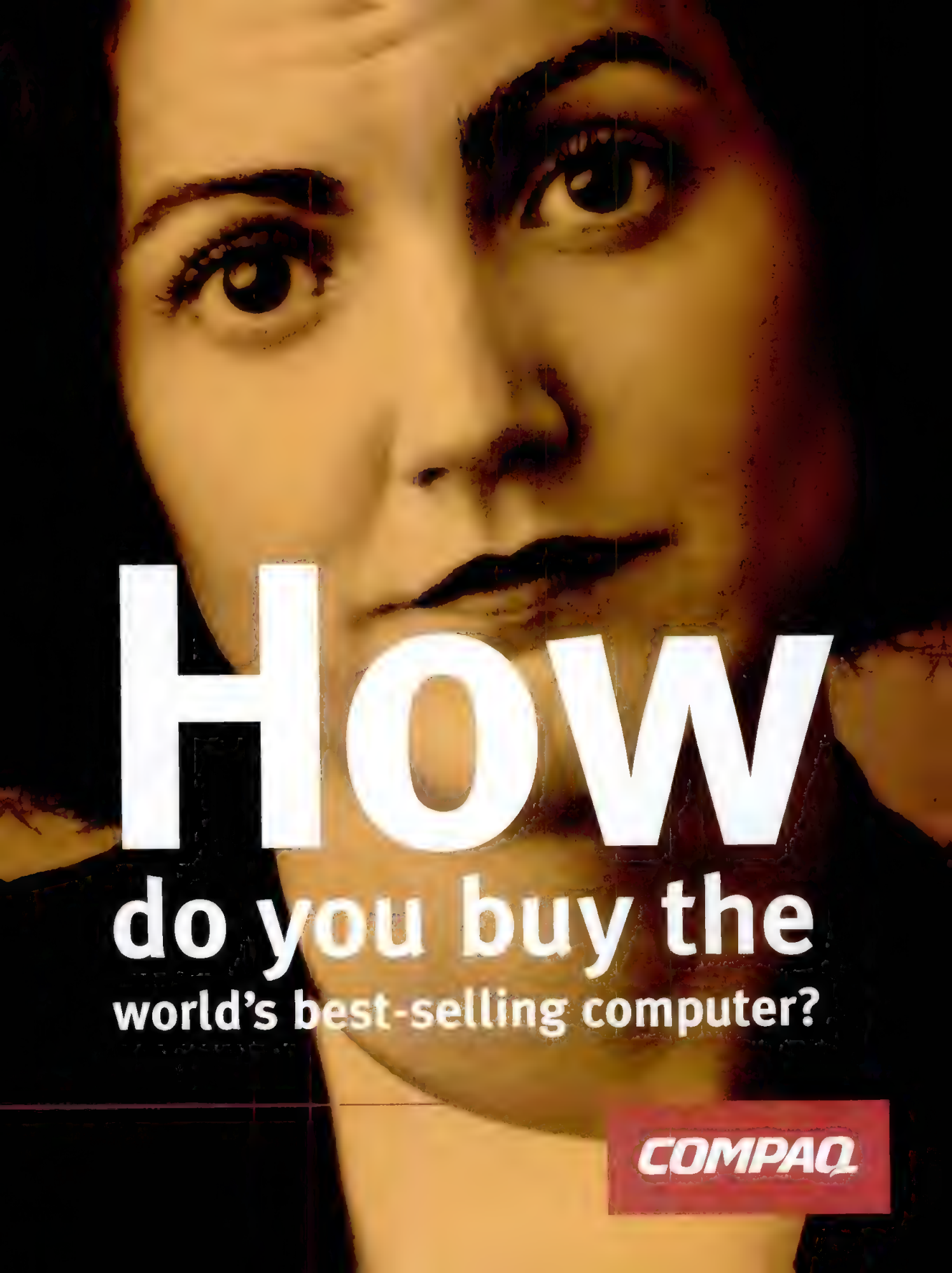
The YesBook has a one-year warranty; technical support (not toll-free) is available during business hours on weekdays. Solid performance and a good price make the YesBook worth a second look if you're in the market for a high-end system.—*AT*

MetroBook DT, MetroBook LT

MetroBook DT: Pentium MMX/266, 15.1" TFT, 3.9GB disk, 64MB EDO DRAM, 10.1 lbs. Battery: 3:12. Winstone 98: 16.4. $4,500 street.
MetroBook LT: Pentium MMX/266, 13.1" TFT, 3.9GB disk, 32MB EDO DRAM, 6.1 lbs. Battery: 4:02. Winstone 98: 16.5. $3,250 street. MetroBook Computer Corp., 888-829-5300, 703-222-3300; www.metrobook. com. 521 at www.pcmag.com/infolink.

● Selling mainly through resellers, MetroBook offers two contrasting models: the thin and trim MetroBook LT and the thick and wide MetroBook DT. The DT, an 11.4-pound (travel weight) behemoth, was planned primarily for use in one location or facility. It is one of two systems in this roundup to offer a brilliant 15.1-inch TFT XGA screen. On the other hand, the lightweight LT (6.8 pounds, ready for travel) was designed for the road and has a great battery life.

Like its lower-priced twin—the Fosa AP 8800M (reviewed in this roundup)—the DT, at 2 by 14 by 11.25 inches, does not fit in most standard computer bags. The upside is that the screen is comparable to that of many 17-inch desktop monitors, the keys are full-size, and the keyboard even includes a separate number pad. The three-spindle system can accommodate CD-ROM and floppy disk drives simultaneously. Each drive, as well as the hard disk, can be removed easily. A DVD module is $303. The floppy disk drive swaps out for a ZIP drive ($243), an LS-120 drive ($184), or a second hard disk.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Armada 7362

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- 20X Max CD-ROM[3]; 33.6 Kbps Telephony modem
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Armada 7800

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- 8.0 GB SMART Hard Drive[2]
- 64 MB SDRAM (expandable to 256 MB)[3]
- 14.1" CTFT (1024 x 768) display
- 24X Max CD-ROM[3]; 33.6 Kbps Telephony modem
- Integrated AC Adapter
- Powerful AGP graphics allow for superior graphics while on the road or in the office
- Multibay design allows for easy swapping of options including a second hard drive, second battery, SuperDisk LS-120, or future DVD drive

Common features of Armada 7000 Series

- Optimized for use in a networked environment
- Intelligent Manageability features offer lower total cost of ownership
- Certified for multiple operating systems, including Windows NT 4.0
- 3-year limited warranty provides longer investment protection[5]

Options for Armada 7000 Notebooks

- ArmadaStation Expansion Base for full desktop functionality: **$779[1]**
- ArmadaStation Tower Stand: **$99[1]**
- Compaq Briefcase: **$99[1]**

intel inside
pentium® II

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- ATI RAGE IIC AGP Graphics
- 24X Max CD-ROM[4]; K56flex modem[3]
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- Compaq V75 17" (16" viewable) monitor
- 3-year limited warranty[4]

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- Additional 32 MB SDRAM Memory: **$139**[1]
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Compaq Armada SB

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Armada SB Notebook

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- 20X Max CD-ROM[4]; K56flex modem[3]
- Microsoft Office 97 Small Business Edition included for out-of-the-box productivity
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- 3-spindle design allows simultaneous access to multiple storage devices
- Dual-bay design supports a second battery for even greater power while on the road
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- Intelligent Manageability features offer lower total cost of ownership
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- 32 MB SDRAM
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- Compaq V75 17" (16" viewable) monitor
- Towerable chassis converts from desktop to minitower
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Model 6350X/6400/CDS

$2,139[1]

- Intel Pentium II Processor @ 350 MHz
- 6.4 GB SMART II Ultra ATA Hard Drive[2]
- 64 MB SDRAM
- ATI RAGE PRO TURBO AGP Graphics
- 24X Max CD-ROM[4]
- Compaq V75 17" (16" viewable) monitor
- Towerable chassis converts from desktop to minitower
- 3-year limited warranty[4]

Model 6400X/6400/CDS

$2,269[1]

- Intel Pentium II Processor @ 400 MHz
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- 64 MB SDRAM
- ATI RAGE PRO TURBO AGP Graphics
- 24X Max CD-ROM[4]
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intel inside pentium II

COMPAQ DirectPlus

The LT is a sleek unit that has a modular bay to house either a CD-ROM or a floppy disk drive. The latter can be used externally as well. The LT's screen is clear and bright. An ATI graphics controller lets the system run realistic 3-D graphics scenes. One small problem: The touch pad was very sensitive, making it hard to use.

Both units were mostly average performers for their classes; the DT scored above average on our Winstone test and the LT scored above average on our graphics test. Each system used a lithium ion battery and performed well on our BatteryMark test.

Dragon Naturally Speaking (voice-recognition software) with a headset ships with both units. The units also come with modems, RCA jacks, and USB ports. The port covers on the units do not retract, and the port replicator cover on the LT is not attached at all, so it is easily lost.

MetroBook has technical-support hours during weekdays. The company does not offer on-site service or a guaranteed turnaround policy, but its three-year warranty and feature-rich systems are worth a second look.—*Frank J. Evans*

Micron TransPort Trek, GoBook

TransPort Trek: Pentium MMX/266, 13.3" TFT, 2GB disk, 32MB EDO DRAM, 7.0 lbs. Battery: 3:09. Winstone 98: 15.6. $2,699 direct.
GoBook: Pentium MMX/266, 12.1" TFT, 3.1GB disk, 32MB EDO DRAM, 4.9 lbs. Battery: 6:33. Winstone 98: 15.9. $3,298, direct. Micron Electronics Inc., 888-634-8799, 208-893-3343; www.micronpc.com. 522 at wwww.pcmag.com/infolink.

● Micron's GoBook lightweight notebook is a chameleon, able to assume many identities as you shuffle parts—including a huge base battery. The TransPort Trek is a solid value for buyers who want a reasonable compromise between features, performance, size, and price.

The GoBook, for high-end users, follows the modular approach to lightweight notebook computing. The components you use depend on whether you run the GoBook on AC power or via either of two lithium-ion batteries: a heavyweight, high-capacity 7000-mAh (milliamp hours) base battery or the more common 2000-mAh battery that fits in the modular bay.

With only the modular internal battery installed, the GoBook weighs 5.0 pounds; adding the AC adapter brings it to 5.6 pounds. In this configuration, you have an internal hard disk but no floppy disk drive or CD-ROM drive. With the CD-ROM drive and the wide-base battery installed, the system height increases by half an inch and the weight jumps to 7.6 pounds—8.2 pounds with the AC adapter. The entire package weights 9.8 pounds.

The GoBook's internal and external base batteries are rated at 3-plus and 8-plus hours, respectively, or 11-plus hours when used together. On our BatteryMark test, the base battery alone lasted 6:33; with only the internal battery, the unit lasted just 1:41. With both batteries, life jumps to 8:29. The GoBook was a mostly average performer, with an above-average score on our CD-ROM test and a below-average score on our Winstone test within the lightweight category.

Micron GoBook

At its 7.6-pound travel weight, the TransPort Trek was one of the lighter notebooks in this roundup. Its BatteryMark score of 3:09 is good for a unit with a 13.3-inch TFT screen. All other benchmark test scores were average for the value category. The only complaints: The TransPort Trek's touch pad was a little off-center, with stiff buttons that required higher-than-average pressure to activate. Also, upgrades are difficult for users to perform.

The versatility of the GoBook lends itself to diverse applications, and the TransPort Trek lives up to its name with a good travel weight and a long battery life.—*BB*

Mitsuba Dynasty 500

AMD K6/266, 12.1" TFT, 3.1GB disk, 32MB SDRAM, 7.3 lbs. Battery: 1:12. Winstone 98: 15.4. $2,000 street. Mitsuba Corp., 800-648-7822, 909-392-2000; www.mitsuba.com. 523 at www.pcmag.com/infolink.

● Mitsuba aims its new Dynasty series of modular notebooks at users who need high-end graphics and communications capabilities. The company squeezes a good deal of connectivity hardware into its value notebook, the AMD K6/266–based Dynasty 500, but the unit's performance was unremarkable and its battery life is one of the shortest in this roundup.

The Dynasty 500 comes with two USB ports and a NTSC video-out port, plus a MIDI port and an IR port, but it lacks an expansion bus for a docking station. Although the hard disk slides out easily, removing the lithium ion battery is almost a three-handed operation: Two latches must be pushed sideways as you pull on the battery. Microsoft Office 97 Small Business Edition and a combination Intel EtherExpress PRO/100 Ethernet adapter/56-Kbps fax modem card are bundled with the unit (included in the price).

The Dynasty 500, at a travel weight of 8 pounds, is a three-spindle system that includes a fixed 20X CD-ROM drive. The floppy disk drive can be swapped for a second battery, which you may want to consider, since the system lasted just 1:12 on our BatteryMark test despite its lithium ion technology.

The unit's Business Winstone 98 score placed it roughly between the Pentium MMX/233 and Pentium MMX/266 units in this roundup. Test results were mostly average for the Dynasty 500's class, but its Business Disk WinMark 98 score was

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Monitor	GS771	PS790
Screen Size/ Viewable	17" (16.0" viewable)	19" (18.0" viewable)
Dot Pitch	.27	.25
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below average. Mitsuba backs the unit with a two-year warranty.

A good price and average features recommend the Dynasty 500, but its brief battery life is a significant drawback.—*RSA*

NEC Versa LX, Versa SX

Versa LX: Pentium II/266, 14.1" TFT, 3.9GB disk, 64MB SDRAM, 7.3 lbs. Battery: 2:59. Winstone 98: 19.9. $4,300 street.
Versa SX: Pentium II/266, 14.1" TFT, 3.1GB disk, 32MB SDRAM, 5.4 lbs. Battery: 2:22. Winstone 98: 18.8. $4,000 street. NEC Computer Systems Division, 888-863-2669, 508-264-8000; www.nec-computers.com. 524 at www.pcmag.com/infolink.

PC MAGAZINE EDITORS' CHOICE

With sleek, silver polycarbonate cases, the new NEC Versa LX and Versa SX notebooks stand out. The Versa SX subnotebook, 1.4 inches thick and 6.2 pounds (travel weight), will likely be a hit thanks to its portability and power. The Versa LX, an Editors' Choice, has a convenient three-spindle design and a travel weight of just 8.2 pounds.

With an eye toward MIS needs, the Versa SX and Versa LX share common components, including drive (save for floppy) and battery modules, memory modules, AC adapters, and docking stations. This enables corporate customers to standardize and support users with a smaller inventory of parts. Both offer 14.1-inch TFT XGA displays that use NEC's 0.25-inch-thick screen technology, and both have lithium ion batteries. Both units also have deep palm rests and comfortable, quiet keyboards.

Among presentation units, the Versa LX was an above-average performer on our CPU, graphics, and CD-ROM tests. Its Winstone and Disk WinMark 98 scores were average. The unit lasted nearly 3 hours on our battery tests. The Versa LX is also available in a corporate value version with a 12.1-inch display and a 200- or 233-MHz Pentium MMX processor—at a street price starting just above $2,200.

Attaching and changing peripherals and modules was fast and easy with the Versa SX. We noticed no inconsistencies or operational hitches in testing with an early production version of the unit. Although the Versa SX is very portable, its battery life was 2:22; you may want to keep an extra battery handy.

NEC Versa LX

The Versa SX is available with Pentium II and mobile MMX processors. The tested unit posted above-average CD-ROM WinMark 98, $CPUmark_{32}$, and Graphics Winmark 98 scores within its class, but it earned a below-average Disk WinMark score.

NEC Computer Systems Division backs both NEC notebooks with a three-year parts-and-labor warranty; service and support is available 7 days, 24 hours. Good looks, good performance, and interchangeable parts make the Versa SX and Versa LX great choices for corporate users, professionals, and demanding mobile workers.—*BB*

ProGen Venture MMX266

Pentium MMX/266, 13.3" TFT, 3.9GB disk, 64MB EDO DRAM, 7.6 lbs. Battery: 2:52. Winstone 98: 16.7. $2,150 street. ProGen Systems Inc., 800-848-1353, 714-566-9200; www.progen.com. 525 at www.pcmag.com/infolink.

● Business travelers who are looking for a desktop replacement system and don't need the latest, extra boost of Pentium II performance will find a solid deal in the ProGen Venture MMX266. The value-class Venture adds a 13.3-inch TFT screen and lithium ion battery power to a fine three-spindle design.

The unit had above-average scores for its class on our $CPUmark_{32}$, Graphics Winmark 98, and Winstone tests; it was average on the other benchmark tests. With a time of 2:52 on the BatteryMark test, the Venture can handle itself fairly well on the road, but you might consider buying an extra $199 battery to extend working time away from AC power. The unit's travel weight is 8.4 pounds.

The Venture's case construction, keyboard action, and support for warm-swapping of the battery are all pluses. You can't swap hard disks, however, and you have to remove screws to access the memory-upgrade compartment. The USB port is on the back of the notebook, but even with cables plugged into all the other ports, there is room for a USB cable.

One problem: Although the unit's Trident Cyber 9397 graphics chip set with 4MB of SGRAM does well in SVGA and XGA resolution at most color depths, the driver drops graphic elements at 256 colors.

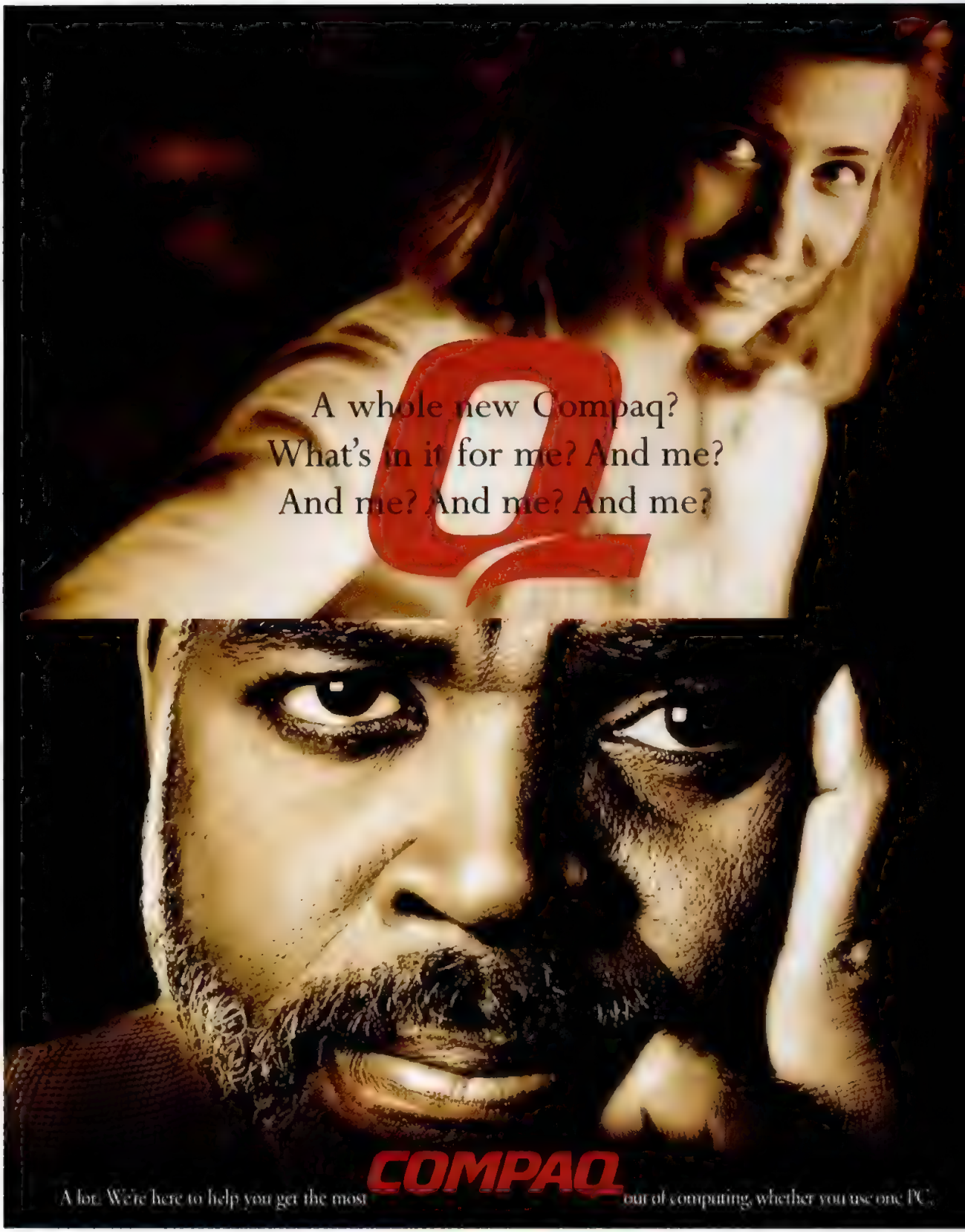
Solid performance and good battery life put the Venture ProGen MMX266 on the watch list for mobile workers looking for a capable traveling business tool. Be sure to get a graphics driver update.—*BB*

Quantex H-1331 with PII/266MHz

H-1331 with PII/266MHz: Pentium II/266, 13.3" TFT, 3.9GB disk, 64MB SDRAM, 6.6 lbs. Battery: 2:02. Winstone 98: 18.6. $2,999 direct. Quantex Microsystems Inc., 800-346-6572, 732-563-4166; fax, 732-563-0407 www.quantex.com. 526 at www.pcmag.com/infolink.

● Quantex Microsystems offers an adequate portable solution and a good value in its high-end Quantex H-1331 with PII/266MHz.

The H-1331 is an interesting package. The case has one modular bay, which can hold either a 24X CD-ROM drive or a floppy disk drive; both come standard. You also get a mini docking station, a 56-Kbps PC Card modem, a second battery that fits into the media bay, and a bundled copy of Microsoft Office 97 Small Business Edition as part of this package (included in the price above). The unit's TFT display can handle XGA resolution.



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SUMMARY OF FEATURES

Notebooks

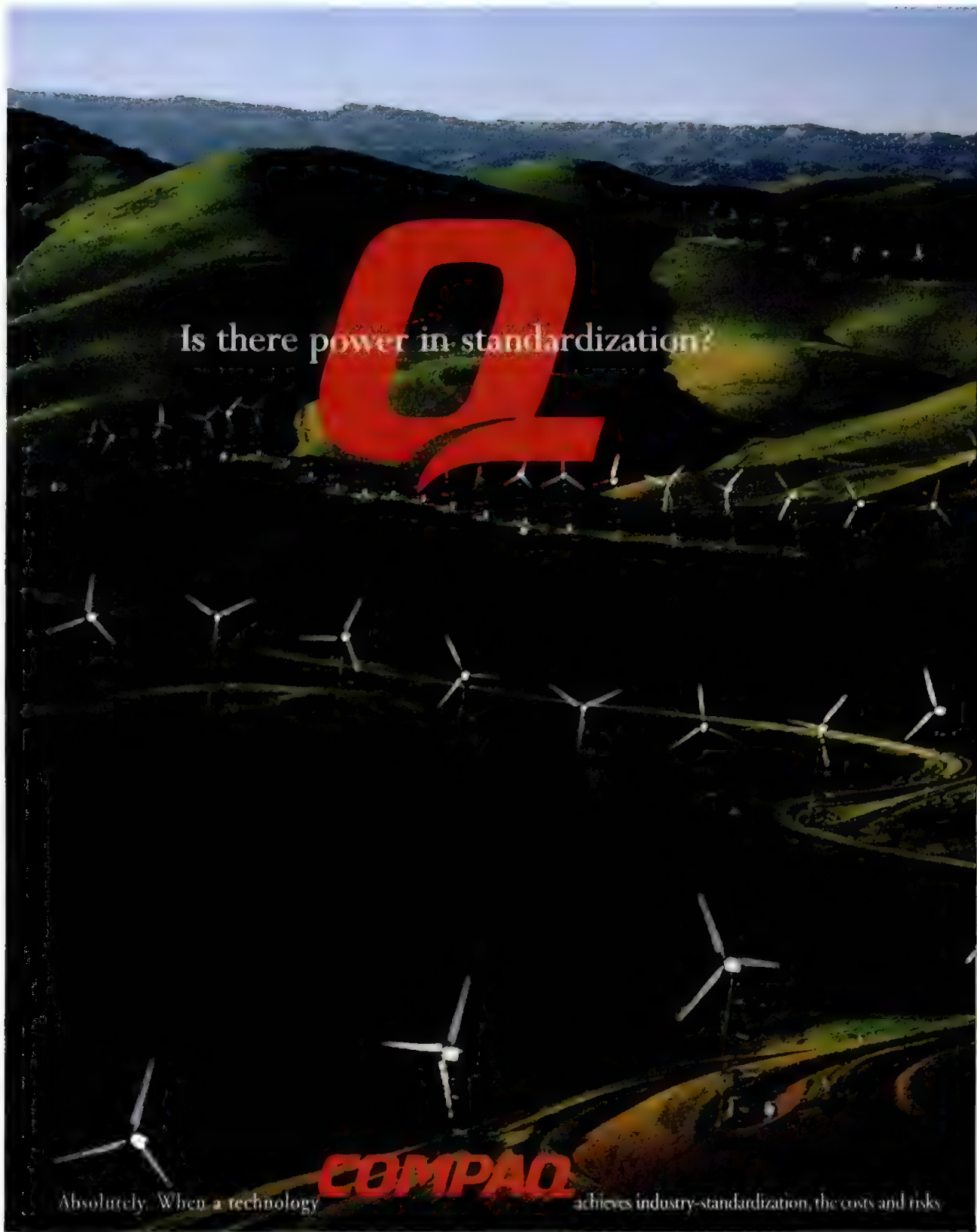
■ YES ☐ NO Products listed in review order	Acer Extensa 367D	Alcam XL791	Alcam XL662	ACT Innomation 5133LE	AMS Rodeo 5032ECX	AMS TravelPro 2500CS	ARMNote TS759
Category	Value	High-end	Value	Value	High-end	Value	High-end
Price of tested configuration	$1,500 street	$2,400 street	$1,590 street	$2,198 direct	$3,800 street	$1,700 street	$3,000 street
Processor	Pentium MMX/200	Pentium MMX/266	Pentium MMX/200	Pentium MMX/233	Pentium II/266	Pentium MMX/233	Pentium II/266
LCD-panel size, type, and resolution	12.1 DSTN SVGA	13.3 TFT XGA	12.1 TFT SVGA	13.1 TFT XGA	14.0 TFT XGA	12.1 TFT SVGA	14.1 TFT XGA
System weight/Travel weight (pounds)	6.4 / 7.3	6.8 / 7.4	6.1 / 6.8	7.8 / 8.6	8.7 / 9.5	7.8 / 8.6	8.4 / 9.2
Dimensions (HWD, in inches)	2.0 x 11.3 x 9.4	1.9 x 12.1 x 9.4	1.8 x 12.1 x 9.4	2.0 x 12.8 x 10.3	2.1 x 12.1 x 10.0	2.0 x 11.9 x 9.3	2.0 x 12.5 x 10.0
Installed/maximum system RAM	32MB / 80MB SDRAM	64MB / 128MB EDO DRAM	32MB / 128MB EDO DRAM	32MB / 128MB SDRAM	64MB / 128MB SDRAM	32MB / 128MB SDRAM	64MB / 256MB EDO DRAM
Installed external RAM cache and type	256K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst
Motherboard manufacturer	Acer	Samsung	Samsung	DM Technology	AMS Technology	AMS Technology	AlphaTop
Chip set	ALI 7101	Intel 430TX	Intel 430TX	SiS 55A1	Intel 440BX	OPTi FireStar Plus	Intel 440BX
BIOS manufacturer and version (or date)	Acer 3.0	Phoenix 4.05	Phoenix 4.05	Award 4.51A	Phoenix 4.0	Award 4.51	Phoenix 4.0
Display and Storage							
Graphics chip set	NeoMagic MagicGraph 128ZV+ PCI	Cirrus Logic GL-CD7556 PCI	NeoMagic MagicGraph 128XD PCI	S3 ViRGE/MX PCI	Trident Cyber 9397 PCI	NeoMagic MagicGraph 128XD PCI	Trident Cyber 9397 PCI
Graphics memory size and type	1MB DRAM	2MB DRAM	2MB DRAM	4MB SGRAM	4MB SGRAM	2MB DRAM	4MB SGRAM
Maximum external resolution	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,600 x 1,200
Hard disk	2GB IBM DYKA-22160	3.9GB Toshiba MK4006MAV	3GB Fujitsu MHA2032AT	3GB Toshiba MK3205MAV	3.9GB Toshiba MK4006MAV	3.1GB Toshiba MK3205MAV	4.8GB IBM DPLA-25120
Floppy disk drive	External	Swappable	Swappable	Swappable	Swappable	Swappable	Internal
Multimedia Features							
CD-ROM or DVD drive speed and model	24X TEAC CD-220E	24X Toshiba XM-1702B	20X Toshiba XM-1602B	20X Mitsumi SR 200S	20X Toshiba XM-1602B	24X Matsushita UJDA150	24X Toshiba XM-1702B
DVD type	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MPEG-2 support	None	None	Software	None	None	None	None
MPEG-2 hardware decoder chip	N/A	N/A	N/A	NA	N/A	N/A	N/A
MIDI synthesis type	FM, wavetable	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable
NTSC video-in/video-out	☐ ☐	☐ ☐	☐ ☐	☐ ■	☐ ■	☐ ☐	☐ ☐
PAL video-in/video-out	☐ ☐	☐ ☐	☐ ☐	☐ ■	☐ ■	☐ ☐	☐ ☐
Communications and Expansion							
Modem type (data speed, in Kbps)	Integrated (56)	PC Card (56)	Integrated (56)	PC Card (56)	Integrated (56)	N/A	PC Card (56)
Cellular-capable modem	☐	☐	☐	☐	☐	☐	☐
PC Card slots	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III
CardBus socket/Zoomed video support	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ☐
Miscellaneous							
BIOS password/Lock	■ ■	■ ☐	■ ☐	☐ ■	☐ ■	☐ ■	■ ☐
ECP/EPP interfaces	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
External keyboard and mouse ports	Shared	Shared	Shared	Shared	Shared	Shared	Shared
Full-size cursor keys	☐	☐	☐	☐	■	■	☐
Type of pointing device	Touch pad	Touch pad	Touch pad	Touch pad	Touch pad	Touch pad	Touch pad
Battery type	Nickel hydride	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Nickel hydride	Lithium ion
SMART battery	■	■	■	■	■	■	■
Rated charge time while on/off (hours:minutes)	6:00 / 2:00	3:00 / 6:00	3:00 / 6:00	4:00 / 6:00	8:00 / 5:00	4:00 / 2:00	N/A / 4:00
Standby/hibernation mode	■ ■	■ ■	■ ☐	■ ■	■ ■	■ ■	■ ■
Options Prices							
Docking station/Port replicator	N/A	N/A / $200	N/A / $200	$198 (combination)	N/A / $210	N/A / $210	$400 / $200
Spare battery	$100	N/A	N/A	$168	$190	$110	$200
DVD drive	N/A	N/A	N/A	N/A	$400	N/A	$400
LS-120 drive/Zip drive	N/A	N/A	N/A	N/A	N/A	N/A	N/A / $250
Service and Support							
Minimum dead pixels for service	3	5	5	5	9	9	5
Standard warranty on parts/labor	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	1 year/1 year
On-site service charge	N/A	N/A	N/A	N/A	N/A	N/A	Included (1 year)
24-hour, 7-day live technical support	■	☐	☐	☐	☐	☐	■
24-hour turnaround for parts replacement	☐	☐	☐	☐	☐	☐	☐

N/A—Not applicable: The product does not have this feature.

See **www.pcmag.com** for interactive views

Continues

	Brick Ergo BigScreen[4]	**ChemBook 3300**	**Compaq Armada 7800**	**Compaq Presario 1640**	**Compaq Armada 1571DM**	**Dell Latitude CPi D266XT**	**Dell Inspiron 3000 M233XT**	**DFI 6730**	**Digital HiNote VP 765**
	High-end	Value	High-end	Value	Value	High-end	Value	Value	High-end
	$2,995 direct	$1,499 direct	$5,400 street	$2,500 street	$2,200 street	$3,299 direct	$2,099 direct	$2,100 street	$3,300 street
	Pentium MMX/266	Pentium MMX/233	Pentium II/266	AMD K6/266	Pentium MMX/200	Pentium II/266	Pentium MMX/233	Pentium MMX/200	Pentium II/266
	14.1 TFT XGA	12.0 TFT SVGA	13.3 TFT XGA	12.1 TFT SVGA	12.1 DSTN SVGA	13.3 TFT XGA	13.1 TFT XGA	13.1 TFT XGA	13.1 TFT XGA
	8.6 / 9.3	7.3 / 8.0	8.6 / 9.0	7.3 / 8.1	7.4 / 7.9	6.5 / 7.4	6.8 / 8.1	7.8 / 8.6	7.5 / 8.2
	2.3 x 12.2 x 10.2	2.0 x 11.6 x 9.4	2.0 x 12.6 x 10.2	2.1 x 11.9 x 9.6	2.2 x 11.9 x 9.6	1.6 x 12 x 9.5	2.0 x 11.9 x 9.2	2.0 x 12.4 x 10.0	2.0 x 12 x 9.5
	64MB / 192MB SDRAM	32MB / 96MB EDO DRAM	64MB / 256MB EDO DRAM	32MB / 96MB EDO DRAM	32MB / 96MB EDO DRAM	64MB / 128MB EDO DRAM	32MB / 144MB SDRAM	32MB / 128MB EDO DRAM	64MB / 144MB SDRAM
	512K pipelined-burst	256K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst
	Chicony	Mitac	Compaq	Compaq	Compaq	Quanta	Compal	Clevo	Compal
	Intel 430TX	Intel 430TX	Intel 440BX	OPTi FireStar 3.2	OPTi FireStar Plus	Intel 440BX	Intel 430TX	Intel 430TX	Intel 440BX
	Phoenix 4.0	SystemSoft R1.05	Compaq (3/14/98)	Phoenix 4.0	Compaq (3/14/98)	Phoenix 4.0	Phoenix 4.0	SystemSoft 1.01	Phoenix (4/8/98)
	Chips & Technologies 65555 PCI	Trident Cyber 9385 PCI	S3 ViRGE/MX AGP	NeoMagic MagicGraph 128XD PCI	Chips & Technologies 65554 PCI	NeoMagic MagicGraph 128XD PCI	NeoMagic MagicGraph 128XD PCI	S3 ViRGE/MX PCI	NeoMagic MagicGraph 128XD PCI
	4MB EDO DRAM	2MB EDO DRAM	4MB SGRAM	2MB DRAM	2MB EDO DRAM	2MB DRAM	2MB DRAM	4MB SGRAM	2MB DRAM
	1,600 x 1,200	1,024 x 768	1,600 x 1,200	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
	4.8GB IBM DPLA-25120	3GB Toshiba MK3205MAV	4.8GB IBM DPLA-25120	3.9GB Fujitsu MHC2040AT	3.1GB IBM DTCA-23240	4GB IBM DTCA-24090	2GB IBM DTNA-22160	2GB Toshiba MK2104MAV	4GB IBM DTCA-24090
	Swappable	Internal	Swappable	Internal	Internal	Swappable	Swappable	Swappable	Swappable
	24X Matsushita UJDA150	20X Matsushita UJDA110	20X TEAC CRD-S311	24X Toshiba XM-1702B	20X Matsushita UJDA120	20X Torisan CDR-U200	24X Toshiba XM-1702B	24X Toshiba XM-1702B	24X Toshiba XM-1702B
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	None	None	None	None	None	None	None	None	None
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Wavetable	FM	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable
	PC Card (56)	PC Card (56)	Integrated (33)	Integrated (56)	Integrated (56)	PC Card (56)	PC Card (56)	N/A	N/A
	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III
	Shared	Shared	Shared	Shared	Shared	Shared	Shared	Shared	Shared
	Touch pad	Touch pad	Pointing stick	Touch pad	Touch pad	Touch pad	Touch pad	Touch pad	Touch pad
	Lithium ion	Nickel hydride	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion
	2:00 / N/A	5:00 / 3:00	5:00 / 3:00	1:30 / 1:30	3:00 / 1:30	1:00 / 1:00	2:30 / 1:30	4:00 / 2:00	4:00 / 2:00
	$595 / $195	N/A	$800 / N/A	N/A / $120	N/A / $290	$649 / $349	$159 / N/A	$495 / N/A	N/A / $160
	$169	$90	$200		$200	$169	$129	$200	$270
	$300	N/A	N/A	N/A	N/A	N/A	$299	$259	N/A
	$200 / $250	N/A	$230 / N/A	N/A	N/A	N/A	N/A	$380 / $260	N/A / $350
	3	5	3		3	Varies	Varies	3	
	4 years/4 years	1 year/3 years	3 years/3 years	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years
	N/A	N/A	$149 (3 years)	$149 (3 years)	$149 (3 years)	N/A	N/A	Included (1 year)	$149 (1 year)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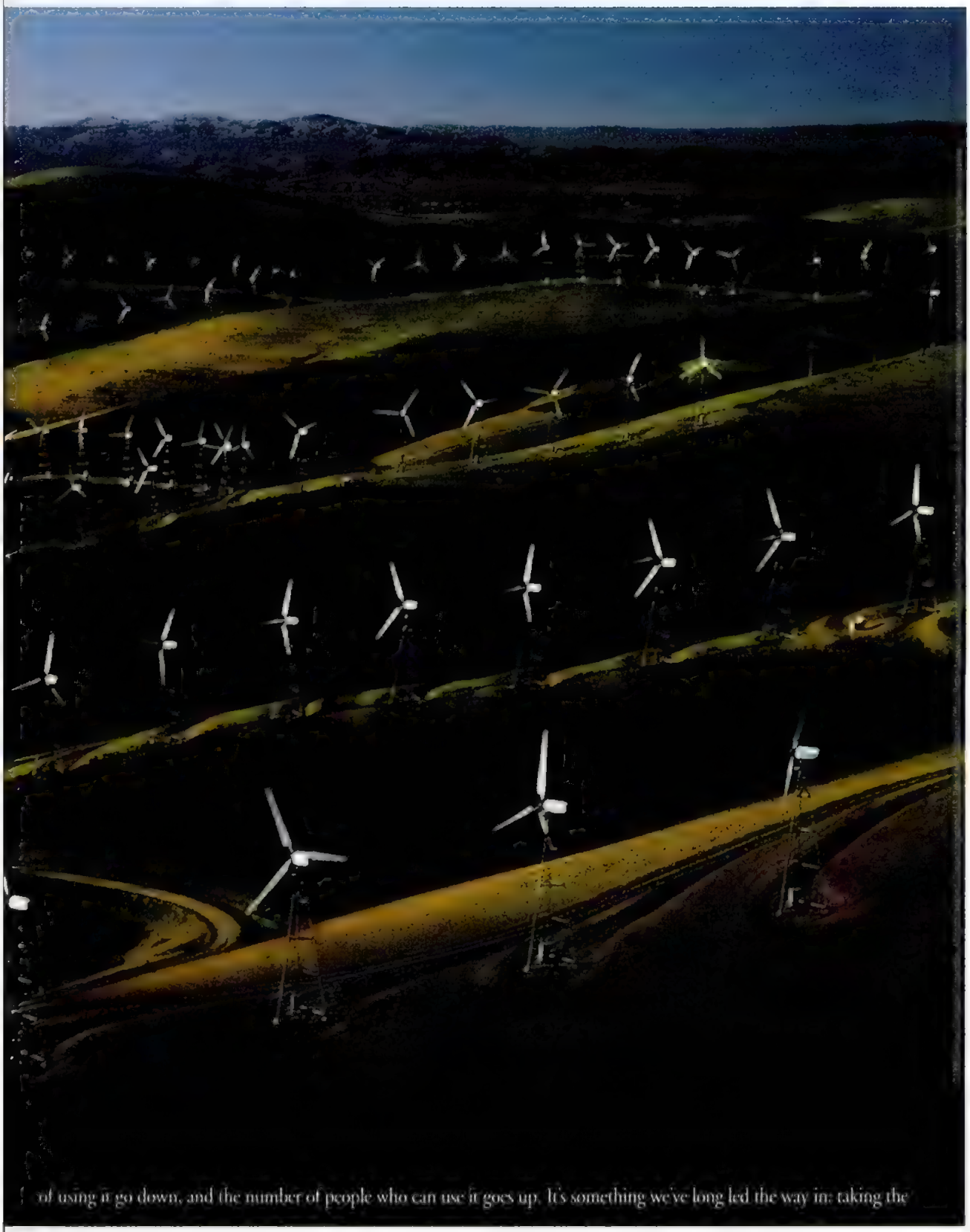

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SUMMARY OF FEATURES

Notebooks

■ YES ▫ NO Products listed in review order	Digital HiNote Ultra2000 GTX 5266M	DTK FortisPro Top5A233	Fosa AP 8800M	Fosa AP 6100T	FutureTech FutureMate 6300XL2	PC MAGAZINE EDITORS' CHOICE Gateway Solo 9100LS	PC MAGAZINE EDITORS' CHOICE Gateway Solo 2500SE
Category	Value	Value	High-end	Value	High-end	High-end	Value
Price of tested configuration	$4,000 street	$1,950 street	$3,700 street	$1,800 street	$3,000 street	$3,849 direct	$2,149 direct
Processor	Pentium MMX/266	Pentium MMX/233	Pentium MMX/266	Pentium MMX/233	Pentium II/266	Pentium II/266	Pentium II/233
LCD-panel size, type, and resolution	14.1 TFT XGA	12.1 TFT SVGA	15.1 TFT XGA	12.1 TFT SVGA	13.3 TFT XGA	14.1 TFT XGA	12.1 TFT SVGA
System weight/Travel weight (pounds)	6.7 / 7.3	7.1 / 7.8	10.1 / 11.4	7.5 / 8.7	8.5 / 9.2	8.8 / 9.7	6.9 / 7.7
Dimensions (HWD, in inches)	1.3 x 12.0 x 10.0	1.8 x 12.4 x 9.5	2.1 x 14.0 x 11.3	2.3 x 12.0 x 9.5	1.9 x 12.6 x 9.7	2.2 x 12.3 x 9.5	2.0 x 11.5 x 9.2
Installed/maximum system RAM	32MB / 144MB EDO DRAM	32MB / 144MB EDO DRAM	64MB / 128MB SDRAM	32MB / 128MB SDRAM	64MB / 144MB SDRAM	64MB / 192MB SDRAM	32MB / 192 MB SDRAM
Installed external RAM cache and type	1MB pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst
Motherboard manufacturer	LG Electronics	DTK Computer	Kapok	Kapok	ASUS	Gateway	Gateway
Chip set	NSC Vesuvius	Intel 430TX	Intel 430TX	OPTi FireStar Plus	Intel 440BX	Intel 440BX	Intel 440BX
BIOS manufacturer and version (or date)	SystemSoft 1.01	Pheonix 4.0	SystemSoft 1.17.01	SystemSoft 1 17 01	Pheonix 4.0	Pheonix 4.0	Phoenix 4.0
Display and Storage							
Graphics chip set	Chips & Technologies 65554 PCI	Chips & Technologies 65554 PCI	S3 ViRGE/MX PCI	Chips & Technologies 65555 PCI	NeoMagic MagicGraph 128XD PCI	Trident Cyber 9397 PCI	NeoMagic MagicGraph 128XD PCI
Graphics memory size and type	2MB EDO DRAM	2MB EDO DRAM	4MB SGRAM	2MB EDO DRAM	2MB DRAM	4MB SGRAM	2MB DRAM
Maximum external resolution	1,024 x 768	1,024 x 768	1,600 x 1,200	1,024 x 768	1,024 x 768	1,280 x 1,024	1,024 x 768
Hard disk	3.9GB IBM DTCA-24090	2.9GB Toshiba MK2104MAV	3.9GB Toshiba MK4006MAV	3.1GB Toshiba MK3205MAV	3.9GB Toshiba MK4006MAV	4.8GB IBM DPLA-25120	2GB Hitachi DK226A-21U
Floppy disk drive	Swappable	Swappable	Swappable	Swappable	Swappable	Swappable	Swappable
Multimedia Features							
CD-ROM or DVD drive speed and model	24X Toshiba XM-1702B	24X TEAC CD-220E	20X TEAC CD-224E	20X Matsushita CR-172	20X Toshiba XM-1602B	11X Toshiba SD-C2002 DVD	20X Matsushita UJDA110
DVD type	N/A	N/A	N/A	N/A	N/A	Hardware	N/A
MPEG-2 support	None	None	None	None	None	Hardware	None
MPEG-2 hardware decoder chip	N/A	N/A	N/A	N/A	N/A	C-Cube Ziva-DS	N/A
MIDI synthesis type	Wavetable	FM	Wavetable	FM	Wavetable	FM, wavetable	FM, wavetable
NTSC video-in/video-out	▫ ▫	▫ ■	▫ ▫	▫ ▫	▫ ▫	■ ■	▫ ■
PAL video-in/video-out	▫ ▫	▫ ▫	▫ ▫	▫ ▫	▫ ▫	■ ▫	▫ ■
Communications and Expansion							
Modem type (data speed, in Kbps)	Integrated (56)	PC Card (56)	N/A	N/A	N/A	PC Card (56)	PC Card (56)
Cellular-capable modem	▫	▫	▫	▫	▫	▫	▫
PC Card slots	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III
CardBus socket/Zoomed video support	■ ■	■ ■	■ ■	▫ ▫	■ ■	■ ■	■ ■
Miscellaneous							
BIOS password/Lock	▫ ■	■ ▫	■ ■	■ ■	■ ■	■ ▫	■ ▫
ECP/EPP interfaces	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
External keyboard and mouse ports	Shared	Shared	Shared	Shared	Shared	Shared	Shared
Full-size cursor keys	■	■	▫	▫	▫	■	▫
Type of pointing device	Touch pad	Touch pad	Touch pad	Touch pad	Pointing stick	Touch pad	Touch pad
Battery type	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion
SMART battery	■	■	▫	▫	■	■	■
Rated charge time while on/off (hours:minutes)	4:30 / 4.00	4.00 / 2:00	5:00 / 3:00	5.00 / 3.00	3.00 / 2.00	2:30 / 2:30	3:30 / 3:30
Standby/hibernation mode	■ ■	■ ■	■ ■	■ ▫	■ ■	■ ■	■ ■
Options / Prices							
Docking station/Port replicator	N/A / $160	N/A	N/A / $160	N/A / $160	N/A / $270	$599 / $100	$599 / $100
Spare battery	$220	$120	$150	$150	$200	$200	$200
DVD drive	N/A	N/A	$250	$250	$270	Included	N/A
LS-120 drive/Zip drive	N/A / $350	N/A	N/A / $210	N/A / $210	N/A / $290	N/A	N/A
Service and Support							
Minimum dead pixels for service	1	Varies	5	5	10	Varies	Varies
Standard warranty on parts/labor	3 years/3 years	1–2 years/1–2 years	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year
On-site service charge	$149 (1 year)	N/A	N/A	N/A	N/A	N/A	N/A
24-hour, 7-day live technical support	▫	▫	▫	▫	▫	■	■
24-hour turnaround for parts replacement	▫	▫	▫	▫	■	▫	▫

N/A—Not applicable: The product does not have this feature.

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Continues

	HP OmniBook 7100	HP OmniBook 4100	HP OmniBook 2100	Hitachi VisionBook Plus 5290	IBM ThinkPad 770ED	IBM ThinkPad 380XD	IBM ThinkPad 600	IBM ThinkPad 560X	Maximus Powermax XGA CD Book
	High-end	High-end	Value	Value	High-end	Value	Subnotebook	Subnotebook	High-end
	$5,180 street	$4,550 street	$1,530 street	$2,300 street	$5,800 street	$3,900 street	$4,600 street	$3,100 street	$2,499 direct
	Pentium II/266	Pentium II/266	Pentium MMX/200	Pentium MMX/266	Pentium II/266	Pentium II/266	Pentium II/266	Pentium MMX/233	Pentium MMX/233
	14.1 TFT XGA	14.1 TFT XGA	12.1 DSTN SVGA	12.1 HPA SVGA	14.1 TFT XGA	12.1 TFT SVGA	13.3 TFT XGA	12.1 TFT SVGA	13.3 TFT XGA
	8.7 / 9.5	6.7 / 7.6	6.6 / 7.4	7.0 / 8.6	8.1 / 9.0	7.0 / 8.0	5.5 / 6.5	4.1 / 5.0	7.7 / 8.4
	2.1 x 12.6 x 10.0	1.6 x 12.6 x 10.0	2.0 x 11.8 x 9.3	1.8 x 12.3 x 9.7	2.3 x 12.1 x 10.0	2.3 x 11.6 x 8.9	1.4 x 11.8 x 9.4	1.2 x 11.8 x 8.8	2.5 x 12.1 x 10.6
	64MB / 160MB SDRAM	64MB / 96MB SDRAM	32MB / 96MB EDO DRAM	32MB / 128MB EDO DRAM	64MB / 288MB EDO DRAM	32MB / 96MB EDO DRAM	32MB / 288MB SDRAM	32MB / 96MB EDO DRAM	64MB / 284MB SDRAM
	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	256K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst
	Hewlett-Packard	Hewlett-Packard	Hewlett-Packard	Acer	IBM	IBM	IBM	IBM	Maximus
	Intel 440BX	Intel 440BX	Intel 430TX	Intel 430TX	Intel 440BX	Intel 440BX	Intel 440BX	Intel 430TX	OPTi FireStar Plus
	Phoenix 4.0	Phoenix 4.0	Phoenix 4.0	Phoenix 4.0	IBM IDET 19WW	IBM IFET 12WW	IBM IBET 24WW	IBM IBET 24WW	AMI 1.05
	ATI 3D Rage LT Pro PCI	NeoMagic MagicGraph 128XD PCI	NeoMagic MagicGraph 128XD PCI	NeoMagic MagicGraph 128XD PCI	Trident Cyber 9397 PCI	NeoMagic MagicGraph 128XD PCI	NeoMagic MagicGraph 128XD PCI	NeoMagic MagicGraph 128XD PCI	NeoMagic MagicGraph 128XD PCI
	4MB SGRAM	2MB DRAM	2MB DRAM	2MB VRAM	4MB SGRAM	2MB DRAM	2MB DRAM	2MB DRAM	2MB DRAM
	1,600 x 1,200	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	800 x 600	1,024 x 768	800 x 600	1,024 x 768
	7.8GB IBM DYLA-28100	6.1GB IBM DADA-26480	2GB IBM DKYA-22160	3GB Hitachi DK226A-32	7.8GB IBM DYLA-28100	4.8GB IBM DPLA-25120	3.9GB IBM DTCA-24090	2GB IBM DTNA-22110	3.9GB Toshiba MK4006MAV
	Swappable	Swappable	Swappable	Swappable	Swappable	Internal	Swappable	External	Internal
	24X Torisan CDR-U240	24X Toshiba XM-1702B	24X Torisan CDR-U240	20X Toshiba XM-1602B	11X Toshiba SD-C2002 DVD	24X Sanyo CRD-S372B	24X Toshiba XM-1702B	N/A	24X TEAC CD-220E
	N/A	N/A	N/A	N/A	Hardware	N/A	N/A	N/A	N/A
	None	None	None	None	Hardware	Software	None	Software	None
	N/A	N/A	N/A	N/A	IBM	N/A	N/A	N/A	N/A
	FM	FM	FM	FM	Wavetable	Wavetable	Wavetable	Wavetable	FM, wavetable
	N/A	N/A	N/A	Integrated (56)	Integrated (56)	PC Card (56)	Integrated (56)	N/A	N/A
					■		■		
	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III
	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■	■ ■
	■ ■	■ ■	■ ■	■	■ ■	■ ■	■ ■	■ ■	■ ■
	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
	Shared	Shared	Shared	Shared	Mouse only	Mouse only	Mouse only	Mouse only	Both
					■		■	■	■
	Touch pad and pointing stick	Touch pad and pointing stick	Touch pad	Touch pad	Pointing stick	Pointing stick	Pointing stick	Pointing stick	Touch pad
	Lithium ion	Lithium ion	Nickel hydride	Nickel hydride	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion
	■		■	■	■		■		■
	3:00 / 2:00	2:30 / 1:30	2:00 / 1:30	5:00 / 2:30	2:30 / 2:00	2:30 / 2:00	2:30 / 2:00	2:30 / 2:00	2:00 / 2:00
	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
	$800 / $200	$800 / $200	$800 / $200	$300 / N/A	$700 / $200	N/A / $300	$700 / $200	N/A / $300	$395 / N/A
	$250	$250	$250	$90	$280	$260	$280	$250	N/A
	N/A	N/A	N/A	N/A	Included	N/A	N/A	N/A	N/A
	N/A / $250	$130 / N/A	$130 / N/A	$200 / N/A	N/A	N/A	N/A	N/A	N/A
	15	15	15	5	7	7	7	7	7
	3 years/3 years	3 years/3 years	1 year/1 year	1 year/1 year	3 years/3 years	1 year/1 year	3 years/3 years	1 year/1 year	1 year/1 year
	N/A	N/A	N/A	N/A	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	$79.99 (2 years)
	■	■	■	■	■	■	■	■	

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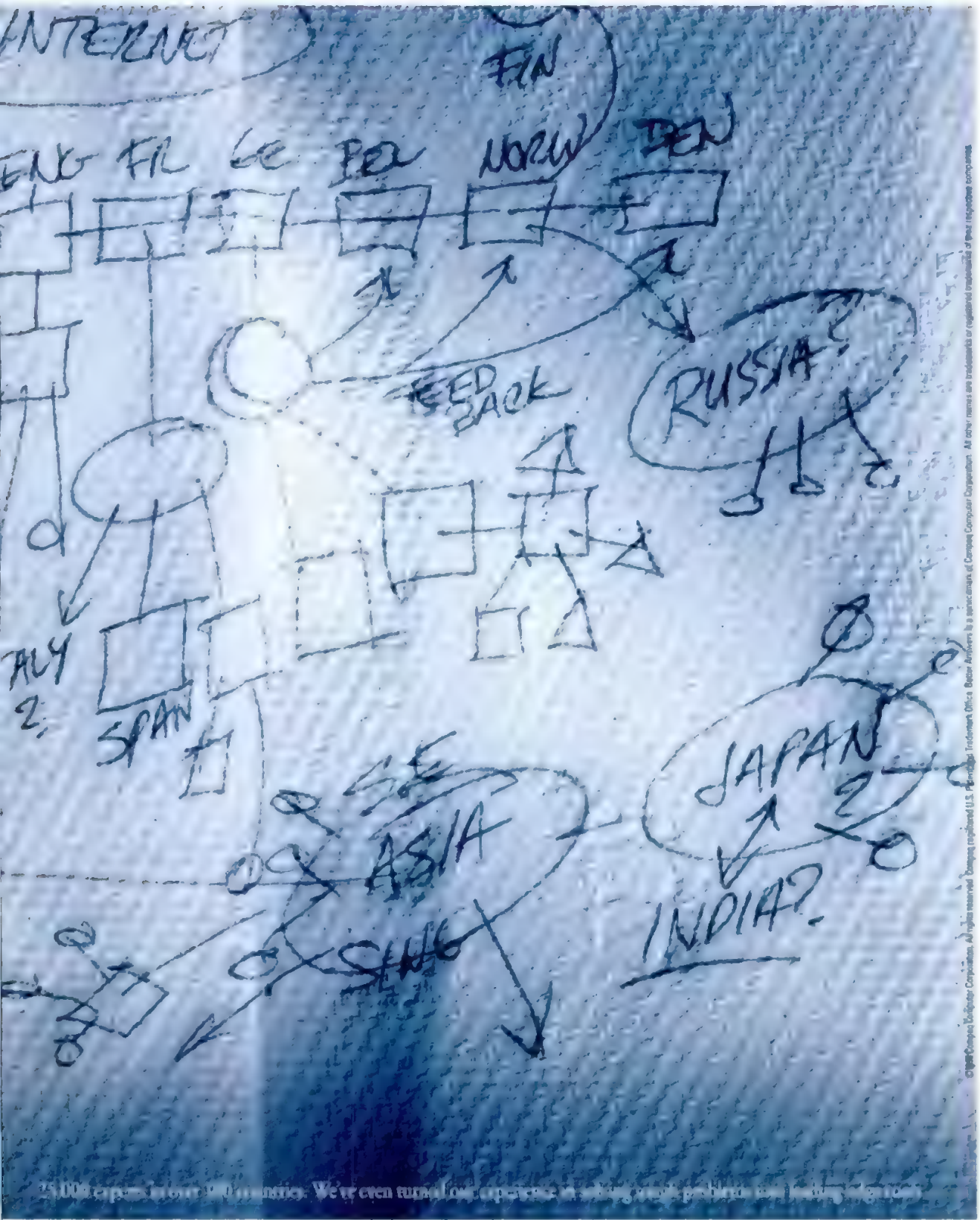

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SUMMARY OF FEATURES

Notebooks

■ YES ■ NO Products listed in review order	Maximus Medisnote CD Book	MaxTech YesBook X759	MetroBook DT	MetroBook LT	Micron TransPort Trek	Micron GoBook	Mitsuba Dynasty 500
Category	Value	High-end	High-end	Value	Value	Subnotebook	Value
Price of tested configuration	$1,499 direct	$3,200 street	$4,500 street	$3,250 street	$2,699 direct	$3,299 direct	$2,000 street
Processor	Pentium MMX/200	Pentium II/266	Pentium MMX/266	Pentium MMX/266	Pentium MMX/266	Pentium MMX/266	AMD K6/266
LCD-panel size, type, and resolution	12.1 DSTN SVGA	14.1 TFT XGA	15.1 TFT XGA	13.3 TFT XGA	13.3 TFT XGA	12.1 TFT SVGA	12.1 TFT SVGA
System weight/Travel weight (pounds)	7.3 / 8.6	8.4 / 9.2	10.1 / 11.4	6.1 / 6.8	7.0 / 7.6	4.9 / 5.6 (8.1[1])	7.3 / 8.0
Dimensions (HWD, in inches)	2.6 x 12.0 x 9.4	2.0 x 12.6 x 10.1	2.0 x 14 x 11.3	1.8 x 12.5 x 9.8	1.8 x 12.3 x 9.4	1.4 x 11.6 x 9.0	2.3 x 12.6 x 9.2
Installed/maximum system RAM	32MB / 128MB SDRAM	64MB / 256MB SDRAM	64MB / 128MB EDO DRAM	32MB / 96MB EDO DRAM	32MB / 144MB EDO DRAM	32MB / 192MB EDO DRAM	32MB / 96MB SDRAM
Installed external RAM cache and type	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	256K pipelined-burst
Motherboard manufacturer	Maximus	MaxTech	Kapok	Samsung	Sanyo	Sanyo	Mitsuba
Chip set	OPTi FireStar Plus	Intel 440BX	Intel 430TX	Intel 430TX	Intel 430TX	Intel 430TX	SiS 5120
BIOS manufacturer and version (or date)	Phoenix 4.0	Phoenix 4.0	SystemSoft 1.17.01	Phoenix 4.0	SystemSoft 1.17.01	Phoenix 4.0	Award 4.51
Display and Storage							
Graphics chip set	Chips & Technologies 65554 PCI	Trident Cyber 9397 PCI	Chips & Technologies 65555 PCI	ATI 3D Rage LT PCI	NeoMagic MagicGraph 128XD PCI	NeoMagic MagicGraph 128XD PCI	S3 Aurora64v+ PCI
Graphics memory size and type	2MB EDO DRAM	4MB SGRAM	4MB EDO DRAM	2MB SGRAM	2MB DRAM	2MB DRAM	2MB SDRAM
Maximum external resolution	1,024 x 768	1,024 x 768	1,600 x 1,200	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
Hard disk	2GB Toshiba MK2104MAV	4.9GB IBM DPLA-25120	3.9GB Hitachi DK227A-41	3.9GB Hitachi DK227A-41	2GB IBM DYKA-22160	3.1GB IBM DYKA-23240	3.1GB Toshiba MK3205MAV
Floppy disk drive	Internal	Internal	Internal	Internal	Swappable	Swappable	Internal
Multimedia Features							
CD-ROM or DVD drive speed and model	20X Toshiba XM-1602B	24X Toshiba XM-1702B	20X TEAC CD-224E	20X Toshiba XM-1602B	20X Toshiba XM-1602B	24X Sanyo CRD-S342M	20X Matsushita UJDA110
DVD type	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MPEG-2 support	None	None	None	None	None	None	None
MPEG-2 hardware decoder chip	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MIDI synthesis type	FM, wavetable	Wavetable	Wavetable	Wavetable	Wavetable	FM, wavetable	Wavetable
NTSC video-in/video-out	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
PAL video-in/video-out	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Communications and Expansion							
Modem type (data speed, in Kbps)	N/A	N/A	Integrated (56)	PC Card (56)	PC Card (56)	PC Card (56)	PC Card (56)
Cellular-capable modem	■	■	■	■	■	■	■
PC Card slots	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III
CardBus socket/Zoomed video support	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Miscellaneous							
BIOS password/Lock	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
ECP/EPP interfaces	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
External keyboard and mouse ports	Keyboard only	Shared	Shared	Shared	Shared	Shared	Shared
Full-size cursor keys	■	■	■	■	■	■	■
Type of pointing device	Touch pad	Touch pad	Touch pad	Touch pad	Touch pad	Touch pad	Touch pad
Battery type	Nickel hydride	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion
SMART battery	■	■	■	■	■	■	■
Rated charge time while on/off (hours:minutes)	2:00 / 2:00	5:00 / 4:00	12:00 / 6:00	6:00 / 3:00	1:36 / 1:00	1:36 / 1:00	5:00 / 3:30
Standby/hibernation mode	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Options Prices							
Docking station/Port replicator	N/A	N/A / $500	N/A / $120	$370 / $220	N/A / $150	N/A / $200	N/A
Spare battery	N/A	$100	$220	$160	$150	$200 / $350[2]	$180
DVD drive	N/A	$250	$300	N/A	N/A	N/A	N/A
LS-120 drive/Zip drive	N/A	N/A/ $250	$180 / $240	N/A	N/A	N/A	N/A
Service and Support							
Minimum dead pixels for service	7	5	10	10	varies	Varies	1
Standard warranty on parts/labor	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	1–5 years/1 year	1–5 years/1 year	2 years/2 years
On-site service charge	$69.99 (2 years)	N/A	N/A	N/A	N/A	N/A	N/A
24-hour, 7-day live technical support	■	■	■	■	■	■	■
24-hour turnaround for parts replacement	■	■	■	■	■	■	■

N/A—Not applicable: The product does not have this feature. (1) With standard external battery. (2) Base battery.

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Continues

PC MAGAZINE EDITORS' CHOICE

NEC Versa LX	NEC Versa SX	ProGen Venture MMX266	Quantex H-1331 with PII/266	Royal Mobile Pro II	Sceptre SoundX 5560T	Sharp PC-M200	Toshiba Tecra 780DVD	Toshiba Satellite 335CDS
High-end	Subnotebook	High-end	High-end	High-end	High-end	Value	High-end	Value
$4,300 street	$4,000 street	$2,150 street	$2,999 direct	$2,960 street	$2,600 street	$2,900 street	$5,900 street	$2,200 street
Pentium II/266	Pentium II/266	Pentium MMX/266	Pentium II/266	Pentium MMX/233	Pentium MMX/266	Pentium MMX/200	Pentium II/266	Pentium MMX/200
14.1 TFT XGA	14.1 TFT XGA	13.3 TFT XGA	13.3 TFT XGA	14.1 TFT XGA	13.3 TFT XGA	13.3 TFT XGA	13.3 TFT XGA	12.1 TFT SVGA
7.3 / 8.2	5.4 / 6.2	7.6 / 8.4	6.6 / 7.3	8.3 / 9.2	6.9 / 7.6	8.1 / 9.7	7.9 / 8.9	6.5 / 7.2
1.8 x 12.2 x 10.1	1.4 x 12.1 x 9.8	2.0 x 12 x 9.8	2.0 x 11.8 x 9.0	2.5 x 12.1 x 10.0	1.9 x 11.9 x 9.2	2.0 x 12.1 x 10.0	2.1 x 11.9 x 9.5	2.1 x 12.0 x 9.5
64MB / 256MB SDRAM	32MB / 256MB SDRAM	64MB / 128MB EDO DRAM	64MB / 144MB SDRAM	64MB / 192MB SDRAM	64MB / 144MB EDO DRAM	32MB / 128MB EDO DRAM	64MB / 192MB EDO DRAM	32MB / 160MB EDO DRAM
512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst
NEC	NEC	Twinhead	Compal	Innolabs	Sceptre	Intel	Toshiba	Toshiba
Intel 440BX	Intel 440BX	Intel 430TX	Intel 440BX	Intel 430TX	Intel 430TX	Intel 430TX	Intel 440BX	Intel 430TX
AMI (4/1/98)	AMI (4/17/98)	Phoenix 4.0	Phoenix 4.0	SystemSoft 1.01	Phoenix 4.0	Phoenix 4.0	Toshiba 6.20	Toshiba 6.20
ATI 3D Rage LT Pro PCI	Trident Cyber 9388 PCI	Trident Cyber 9397 PCI	NeoMagic MagicGraph 128XD PCI	NeoMagic MagicGraph 128XD PCI	NeoMagic MagicGraph 128XD PCI	Trident 9660/968/938 PCI	S3 ViRGE/MX+ PCI	Chips & Technologies 65555 PCI
4MB SGRAM	2MB SGRAM	4MB SGRAM	2MB DRAM	2MB DRAM	2MB DRAM	2MB EDO DRAM	4MB SGRAM	2MB EDO DRAM
1,600 x 1,200	1,024 x 768	1,600 x 1,200	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,280 x 1,024	1,024 x 768
3.9GB Hitachi DK227A-41	3.1GB IBM DYKA-23240	3.9GB Toshiba MK4006MAV	3.9GB IBM DTCA-24090	3.9GB Toshiba MK4006MAV	3.1GB IBM DTCA-23240	3GB Hitachi DK226A-32	7.8GB IBM DPLA-25120	3.9GB IBM DTCA-24090
Internal	Swappable	Swappable	Swappable	Internal	Swappable	Swappable	Swappable	Internal
24X Toshiba XM-1702B	24X Toshiba XM-1702B	20X Toshiba XM-1602B	20X Toshiba XM-1602B	20X Toshiba XM-1602B	20X Torisan CDR-U200	20X Matsushita UJDA110	11X Toshiba SD-C2002 DVD	20X Toshiba XM-1602B
N/A	N/A	N/A	N/A	N/A	N/A	N/A	Hardware	N/A
Hardware	None	Software	None	None	None	None	Hardware	None
Margi	N/A	N/A	N/A	N/A	N/A	N/A	C-Cube Microsystem	N/A
Wavetable	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable
N/A	N/A	Integrated (56)	N/A	PC Card (56)	N/A	Integrated (56)	Integrated (56)	PC Card (56)
Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	One Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III
Shared	Both	Keyboard only	Shared	Both	Shared	Shared	Shared	Shared
Touch pad	Touch pad	Touch pad	Touch pad	Touch pad	Touch pad	Touch pad	Pointing stick	Pointing stick
Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion
3:30 / 2:00	3:30 / 2:00	7:00 / 4:00	2:30 / 1:30	3:00 / 1:30	4:00 / 1:30	4:00 / 1:30	3:30 / 2:30	7:00 / 2.30
$700 / $160	$700 / $160	N/A / $60	Included / N/A	N/A	N/A / $190	$800 / N/A	$600 / $950	N/A
$130	$130	$200	Included	$120	$230	$200	$260	$260
$150	$150	N/A	N/A	N/A	N/A	N/A	Included	N/A
$200 / $200	$200 / $200	N/A	N/A	N/A / $120	N/A	N/A	N/A	N/A
5	5	10	10	1	8	1	1	1
3 years/3 years	3 years/3 years	1 year/1 year	1-3 years/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/1 year	3 years/1 year
N/A	N/A	$79 (1 year)	Included (1 year)	$144.95 (1 year)	N/A	N/A	Included (1 year)	Included (1 year)

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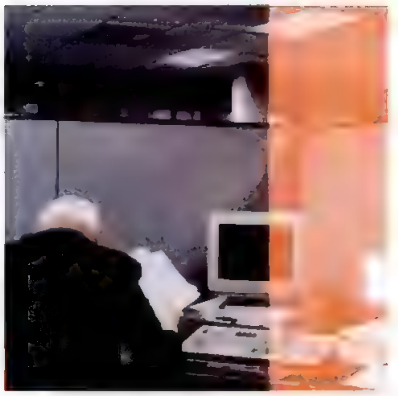

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11:59:59, 1999.

If your users are among the over ten million people who depend on non-Y2K-compliant e-mail systems, they're about to find themselves at the start of the wrong century. Millions of others have already discovered that their systems are behind the times.

Not that it's going to make you feel any better, but there's a reason. Many great systems, Lotus cc:Mail and Microsoft® Mail among them, were designed when e-mail was just a useful utility, and the year 2000 just a blip on the radar. They were never intended to be the critical center of corporate messaging and collaboration that e-mail has become today.

Sure, someone may develop a patch or write some code that will buy you some time to limp into the next century, but that's all you'll be buying. Time. Not capabilities.

So this may be a good time to get your entire company on the same messaging platform. There's a couple of ways to do it.

Alternative one: Yank it all out by the roots, data and all. Start from scratch. Install a completely new messaging infrastructure for your entire installed base and hope it works. Your basic IT nightmare.

Alternative two: Microsoft Exchange Server.

Microsoft Exchange lets you unify your company's messaging platforms. It connects every user around the clock. It connects devices from palmtops to workstations, from 16- and 32-bit PCs to PowerMacs. It connects you to messaging software with unlimited storage for unlimited volume. And, perhaps most important, it connects to the e-mail platforms your company already has—and lets your users keep their e-mail and data alive in the next century.

Exchange comes with built-in connectors to cc:Mail and Microsoft Mail. To Lotus Notes. To mainframe messaging. It supports every standard Internet protocol. And whatever Exchange connects, it enhances. So while your cc:Mail and Microsoft Mail users still keep their data and get their e-mail, they also begin to communicate and collaborate on a global basis. They get the task management, calendaring, contact management and collaboration tools of the Outlook™ 98 client. They can use Microsoft Office to create work, exchange work, collaborate on work. All on a unified platform.

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Notebooks

Ends

■ YES ☒ NO

Products listed in review order	Transmonde Vivanté XL 2266	Transmonde Vivanté SE 2256	Twinhead Slimnote XL	Twinhead Slimnote 9TE	WinBook XLi	WinBook XL 233
Category	High-end	High-end	High-end	Value	High-end	Value
Price of tested configuration	$3,559 direct	$3,259 direct	$2,600 street	$1,500 street	$3,558 direct	$1,599 direct
Processor	Pentium II/266	Pentium II/266	Pentium MMX/266	Pentium MMX/200	Pentium II/266	AMD K6/233
LCD-panel size, type, and resolution	14.1 TFT XGA	13.3 TFT XGA	14.1 TFT XGA	12.1 TFT SVGA	13.3 TFT XGA	12.1 DSTN SVGA
System weight/Travel weight (pounds)	7.4 / 8.2	7.6 / 8.4	7.4 / 8.3	6.9 / 7.8	7.4 / 8.4	7.8 / 8.6
Dimensions (HWD, in inches)	1.8 x 12.5 x 9.8	1.9 x 12.3 x 9.5	2.6 x 12.2 x 10.0	1.1 x 11.3 x 9.7	2.0 x 12 x 9.5	2.0 x 12 x 9.6
Installed/maximum system RAM	64MB / 256MB SDRAM	64MB / 256MB SDRAM	64MB / 128MB EDO DRAM	32MB / 128MB SDRAM	64MB / 128MB SDRAM	32MB / 128MB EDO DRAM
Installed external RAM cache and type	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	256K pipelined-burst	512K pipelined-burst	256K pipelined-burst
Motherboard manufacturer	A.S.E. Technologies	A.S.E. Technologies	Twinhead	Twinhead	Twinhead	Twinhead
Chip set	Intel 440BX	Intel 440BX	Intel 430TX	Intel 430TX	Intel 440BX	Intel 430TX
BIOS manufacturer and version (or date)	SystemSoft 1.01	SystemSoft 1.01	Phoenix 4.0	AMI 1.02	SystemSoft 1.01	SystemSoft 1.01
Display and Storage						
Graphics chip set	Chips & Technologies 65555 PCI	Chips & Technologies 65555 PCI	Trident Cyber 9397 PCI	Chips & Technologies 65554 PCI	Trident Cyber 9397 PCI	Chips & Technologies 65554 PCI
Graphics memory size and type	2MB EDO DRAM	2MB EDO DRAM	4MB SGRAM	2MB EDO DRAM	4MB SGRAM	2MB EDO DRAM
Maximum external resolution	1,280 x 1,024	1,024 x 768	1,600 x 1,200	800 x 600	1,600 x 1,200	1,024 x 768
Hard disk	3.9GB Hitachi DK227A-41	3.9GB Hitachi DK227A-41	3.9GB IBM DTCA-24090	2GB Toshiba MK2104MAV	4.7GB Hitachi DK227A-50	2GB Toshiba MK2104MAV
Floppy disk drive	Internal	Swappable	Internal	Internal	Internal	Internal
Multimedia Features						
CD-ROM or DVD drive speed and model	10X Torisan DRDN216 DVD	11X Toshiba SD-C2002 DVD	20X Toshiba XM-1602B	20X Toshiba XM-1602B	20X Toshiba XM-1602B	20X Toshiba XM-1602B
DVD type	Hardware	Hardware	N/A	N/A	N/A	N/A
MPEG-2 support	Hardware	Hardware	None	None	None	None
MPEG-2 hardware decoder chip	Sigma Designs RealMagic	Sigma Designs RealMagic	N/A	N/A	N/A	N/A
MIDI synthesis type	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable	FM
NTSC video-in/video-out	☒ ☒	☒ ☒	☒ ■	☒ ☒	☒ ■	☒ ☒
PAL video-in/video-out	☒ ☒	☒ ☒	☒ ☒	☒ ☒	☒ ■	☒ ☒
Communications and Expansion						
Modem type (data speed, in Kbps)	Integrated (56)	PC Card (56)	Integrated (56)	Integrated (56)	Integrated (56)	Integrated (56)
Cellular-capable modem	☒	☒	☒	☒	☒	☒
PC Card slots	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two type II or one Type III
CardBus socket/Zoomed video support	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Miscellaneous						
BIOS password/Lock	■ ☒	■ ☒	☒ ☒	☒ ☒	■ ■	■ ■
ECP/EPP interfaces	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
External keyboard and mouse ports	Shared	Shared	Shared	Shared	Shared	Shared
Full-size cursor keys	☒	■	☒	☒	☒	☒
Type of pointing device	Touch pad	Touch pad	Touch pad	Touch pad	Touch pad and pointing stick	Touch pad
Battery type	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Lithium ion	Nickel hydride
SMART battery	☒	■	■	■	■	■
Rated charge time while on/off (hours:minutes)	3:00 / 2:00	3:30 / 2:30	2:00 / 2:00	2:00 / 2:00	4:30 / 4:00	4:30 / 4:00
Standby/hibernation mode	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Options Prices						
Docking station/Port replicator	N/A / $139	N/A / $139	N/A	N/A / $100	N/A / $99	N/A / $99
Spare battery	$179	$199	$180	N/A	$199	$99
DVD drive	Included	Included	$460	$460	N/A	N/A
LS-120 drive/Zip drive	$100 / $180	$180 / $180	N/A	N/A	N/A	N/A
Service and Support						
Minimum dead pixels for service	5	5	4	4	9	9
Standard warranty on parts/labor	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year
On-site service charge	N/A	N/A	N/A	N/A	N/A	N/A
24-hour, 7-day live technical support	☒	☒	☒	☒	☒	☒
24-hour turnaround for parts replacement	■	■	☒	☒	☒	☒

N/A—Not applicable: The product does not have this feature.

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The system has a fairly low 7.3-pound travel weight. Its lithium ion battery posted 2:02 on our BatteryMark test, a below-average timing. An average performer on most tests compared with other notebooks in the high-end category, the unit posted an above-average score on our CD-ROM WinMark 98 test. The graphics score was below average.

Quantex also markets value-class units. The H-1209, with a Pentium MMX/166 processor, formerly Quantex's entry-level notebook, has been replaced by the H-1210 (not reviewed). This two-spindle unit is based on a 233- or 266-MHz Pentium MMX processor and has 32MB of RAM, a TFT display, and a 24X CD-ROM drive. It starts at $1,899.

Quantex offers a one-year warranty on the system unit, with on-site service, and a three-year warranty on the CPU and memory. The high-end H-1331 is a complete package.—*RSA*

Royal Mobile Pro II

Pentium MMX/233, 14.1" TFT, 3.9GB disk, 64MB SDRAM, 8.3 lbs. Battery: 2:02. Winstone 98: 15.9. $2,960 street. Royal Computer Inc., 800-486-0008, 626-855-5077; www.goroyal.com. 527 at www.pcmag.com/infolink.

● Royal Computer targets demanding mobile financial, business, and marketing customers for the Mobile Pro II. Its 14.1-inch TFT screen fulfills the intended high-end role, but the Mobile Pro II's price is relatively high for a system that, despite the name, comes without a Pentium II CPU. The inability to run acceptably in 24-bit video mode is also a limitation, considering the target market.

The Mobile Pro II's 9.2-pound travel weight is a bit high but acceptable for a three-spindle device. Hard disk swapping is easy: You just pop open a cover and pull the disk out. Memory upgrades require a service call, though. Also, the touch pad is awkwardly placed for optimum touch-typing; it should be centered below the space bar.

Graphics-display performance on the big, bright screen was great at both SVGA and XGA resolutions, in 256-color and 16-bit color mode. At 24-bit mode and SVGA resolution, however, the screen font was badly displayed and hard to read. The system's 2MB memory isn't sufficient to run XGA resolution at true color, and users should not be allowed to set it as such (currently, users may set the display to 24-bit XGA resolution).

Given its 233-MHz MMX CPU, the system could not match most other Pentium II–based units in its high-end class on our Business Winstone test suite. Most other test results were average.

Royal Computer Mobile Pro II

The Mobile Pro II isn't a solid choice. Graphics are limited to 16-bit colors, and its Pentium/MMX-class processor suggests that either component upgrades or a lower price are needed for the unit to be competitive. The warranty, too, is lacking: Parts and labor are covered for a year, but a year of on-site service costs $144.95.—*BB*

Sceptre SoundX 5500T

Pentium MMX/266, 13.3" TFT, 3.1GB disk, 64MB EDO DRAM, 6.9 lbs. Battery: 2:32. Winstone 98: 16.6. $2,600 street. Sceptre Technologies Inc., 800-788-2878, 626-369-3698; www.sceptre.com. 528 at www.pcmag.com/infolink.

● Marketed as a mobile unit for business travelers, the high-end Sceptre SoundX 5500T is distributed mainly through resellers. It has enough power to make it a desktop replacement, and its relatively light 7.6-pound travel weight makes it a compelling system, but real road warriors will be put off by its relatively low 2:32 battery score.

The unit's modular bay can support a CD-ROM, floppy disk drive, or second lithium ion battery; the components are not hot swappable. The unit's active-matrix screen supports 1,024-by-768 resolution. We had a problem with the unit's power button, however: Our test unit would not always turn back on after shutting down unless the technicians first removed all the power sources.

Ports are housed in the back of the unit behind a cover that does not retract and may break off during use. Although the test system came with a USB port, the USB driver was not loaded correctly and showed a conflict when we tested it and made installing USB devices extremely difficult. On the other hand, we had no problems with either of the PC Card slots. Both slots support CardBus technology.

The system was an average performer on most of our benchmark tests, no mean feat for a Pentium MMX-based system in a field of Pentium IIs.

The SoundX is lightweight and relatively powerful, but only an experienced user less concerned with battery life should consider it.—*FJE*

Sharp PC-M200

Pentium MMX/200, 13.3" TFT, 3GB disk, 32MB EDO DRAM, 8.1 lbs. Battery: 2:30. Winstone 98: Not run. $2,900, street. Sharp Electronics Corp., 800-237-4277, 201-529-8200; www.sharp-usa.com. 529 at www.pcmag.com/infolink.

● Although Sharp Electronics Corp. markets the PC-M200 as a high-end desktop replacement, it chose to send the unit for review as a value system. The PC-M200 is an attractive two-tone, three-spindle notebook but at $2,900 (street), it is expensive for a unit based on the relatively slow Pentium MMX/200 CPU. Our testing was hampered by the unit's inability to run our Winstone and graphics tests; the unit had a graphics driver problem that Sharp was unable to fix.

The PC-M200's 9.7-pound travel weight is high but acceptable in a three-spindle system. We found a few draw-

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backs to this unit, however: Memory upgrades require the removal of the keyboard, which many users won't want to do, and hard disk swapping isn't a user task. Also, the USB port is located beneath other I/O ports on the back of the unit: You should plug in a USB device before other devices to avoid awkward reaching. In our tested system, we had to reset IRQ and the memory address to get the USB port to work.

Graphics performance in 24-bit color mode isn't acceptable; with the Trident Cyber 9385 chip with 2MB EDO DRAM, you can't run XGA resolution at this color depth, and in SVGA resolution the fonts are not properly displayed. A new driver is probably the solution. Of the tests we could run, the Sharp unit garnered mostly average results, but the CD-ROM WinMark score was below average. The PC-M200's lithium ion battery lasted 2:30 on our test. Extra batteries cost $199.

Reservations about graphics video capability and the high price for its processor class make this otherwise attractive notebook a questionable buy.—*BB*

Toshiba Tecra 780DVD, Satellite 335CDS

Tecra 780DVD: Pentium II/266, 13.3" TFT, 7.8GB disk, 64MB EDO DRAM, 7.9 lbs. Battery: 3:43. Winstone: 19.9. $5,900 street.
Satellite 335CDS: Pentium MMX/266, 12.1" DSTN, 3.9GB disk, 32MB EDO DRAM, 6.5 lbs., Battery: 2:52. Winstone: 14.4. $2,200 street. Toshiba America Information Systems Inc., 888-598-7802, 714-583-3000; www.computers.toshiba.com. 530 at www.pcmag.com/infolink.

● Few vendors can fulfill the needs of both value users and high-end power users as well as Toshiba can. The Toshiba Satellite 335CDS—the retail cousin of the 330CDS, a unit sold through reseller channels—lacks a modular bay, but it does offer three spindles in a reasonably portable chassis. The Toshiba Tecra 780DVD is a hefty desktop replacement with an equally hefty price tag meant for CAD users and other professionals desiring high-end multimedia. Both units are DMI 2.0 compliant.

These handsome machines offer warm-swappable batteries, and easy access to all major components. Their power management is among the best, letting you change several unique settings under Windows 95 and rapidly resume from the suspend state. They each come with a good software package, including Encarta, Microsoft Money, and Quicken.

The Satellite's left flank offers a fixed floppy disk drive and a fixed CD-ROM. Weighing 7.2 pounds with AC adapter, the unit has external brightness and volume control, and surprisingly sharp Yamaha sound. Of course, a value notebook is never without caveat: Its dual-scan display showed washed-out colors; it posted a below-average Graphics WinMark score; and its keys are fairly noisy.

Unlike the Satellite, the Tecra is hardly a good airplane portable. It weighs 8.7 pounds ready for travel and is limited to two spindles. When a right-side modular bay is occupied by Toshiba's DVD drive ($259, included), you can use the machine's 0.6-pound floppy disk drive externally with its 0.5-pound adapter case. You have to change screen brightness settings in the BIOS but the unit does offer an internal cellular-ready modem and an external volume control. Options include a CD-ROM drive ($399), second hard disk, or second battery ($259). Its S3 ViRGE graphics chip set contributed to above-average graphics tests results; other scores were average.

During initial DVD testing, the Tecra's playback was jittery and, in some instances, obviously pixelated. But Toshiba sent us a replacement unit whose DVD solution—built around a Toshiba drive and an MPEG-2 decoder from C-Cubed Microsystems—proved much more adept. Playback wasn't as flawless as that of the Gateway Solo 9100LS, but it was typically clear, smooth, and watchable.

Toshiba once again offers quality notebooks, notable for good battery life and power management.—*CM*

Toshiba Tecra 780DVD

Transmonde Vivanté XL 2266, Vivanté SE 2266

Vivanté XL 2266: Pentium II/266, 14.1" TFT, 3.9GB disk, 64MB SDRAM, 7.4 lbs. Battery life: 2:02. Business Winstone: 17.8. $3,559 direct.
Vivanté SE 2266: Pentium II/266, 13.3" TFT, 3.9GB disk, 64MB SDRAM, 7.6 lbs. Battery life: 3:28. Business Winstone: 17.7. $3,259 direct. Transmonde Technologies Inc., 888-988-2883, 714-562-0928; www.transmonde.com. 531 at www.pcmag.com/infolink.

● Transmonde's two high-end notebook offerings, both built to order, are average-size, average-priced Pentium II systems with salient performance problems.

At 8.2 pounds (travel weight), the Transmonde Vivanté XL 2266 is a three-spindle design that contains a 14.1-inch screen, an integrated floppy disk drive, and a modular bay. In the tested unit, the bay housed a DVD drive, but it can hold an optional CD-ROM drive ($100) or an optional second battery ($179). An LS-120 drive ($100) can be installed in place of the floppy disk drive. The rather testy touch pad occasionally freezes, and resumption from suspend mode is slow.

The Graphics and CD-ROM WinMark scores for the XL were well below average for its high-end class. Performance during informal testing with popular DVD movies was even worse. Even when we adjusted system settings to free up more bandwidth to frame buffer memory, obvious pixelation distorted the picture. Transmonde claims that such pixelation varies from movie to movie (though we saw heavy distortion on each of the disks we used for testing) and is working with RealMagic—the company's DVD partner—to fix the problem.

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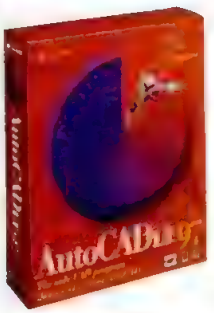

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December 2, 1997
Autodesk AutoCAD LT '97

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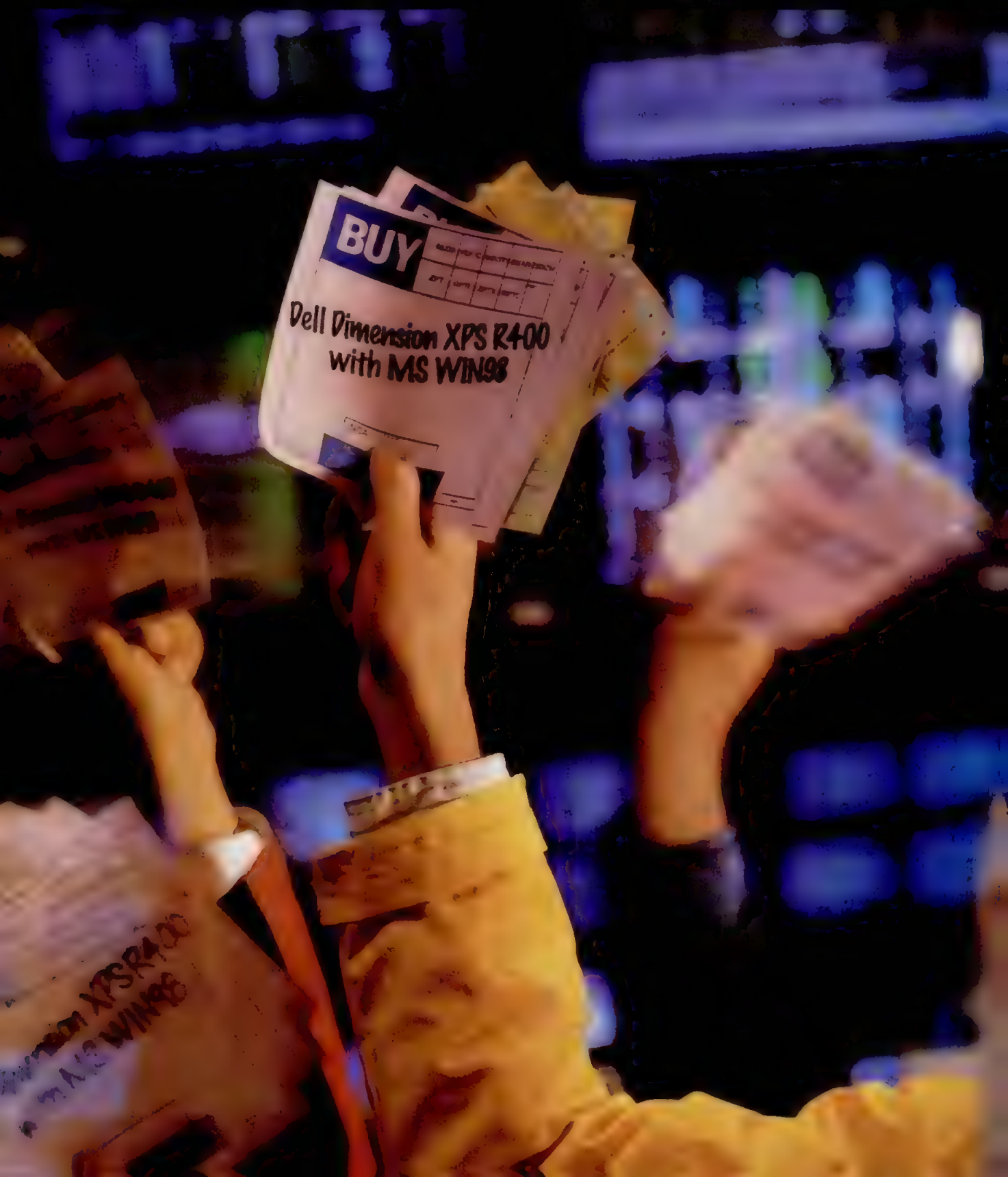

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- ATI Xpert 98D 8MB 3D AGP Video Card
- 32X Max^ Variable CD-ROM Drive
- Yamaha Wavetable Sound
- Altec Lansing ACS-90 Speakers
- Microsoft Office 97 Small Business Edition v2.0 Plus Bookshelf 98; McAfee VirusScan
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intel inside
pentium II

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Transmonde Vivanté SE 2266 weighs in at 8.4 pounds—0.2 pounds heavier than the XL despite a smaller screen (13.3 inches) and no integrated floppy disk drive. A modular bay accommodates a floppy disk, a DVD drive, an LS-120 drive ($180), a Zip ($180), or a CD-ROM ($100). Performance during DVD testing and CD-ROM WinMark was just as poor as that of the XL. Note also that the SE has an unusually problematic power switch. The first two systems sent to us arrived with broken power switches, and Transmonde claims a remarkable 10 percent failure rate on the part.

Transmonde does not offer on-site service but does guarantee 48-hour turnaround for parts replacement. Broken power switches and poor DVD performance leave little to recommend.—*CM*

Twinhead Slimnote XL, Slimnote 9TE

Slimnote XL: Pentium MMX/266, 14.1" TFT, 3.9GB disk, 64MB EDO DRAM, 7.4 lbs. Battery: 3:23. Winstone 98: 14.9. $2,600 street.
Slimnote 9TE: Pentium MMX/200, 12.1" TFT, 2.1GB disk, 32MB SDRAM, 6.9 lbs. Battery: 2:52. Winstone 98: 9.2. $1,500 street. Twinhead Corp., 800-995-8946, 510-492-0828; www.twinhead.com. 532 at www.pcmag.com/infolink.

●Twinhead's Slimnotes have compelling features for the price and good travel weights, but they are hampered by poor performance and driver problems. The Slimnote XL is a high-end professional unit, while the Slimnote 9TE is a value entry-level system. The company sells them mainly through resellers and distributors.

Both Slimnote systems scored below average for their class on most of our tests because of older graphics drivers. The high-end system's Pentium MMX CPU also contributed to its low test results compared with the Pentium II systems in this class. The 9TE was also hurt by its default safe mode, which completely disables its L2 cache. Naturally, this brought down all of its scores, but you can reset this mode in BIOS. The 9TE's CPU score was the lowest in this roundup. Both units had good battery timings using lithium ion batteries, however. And each is fairly portable: The XL weighs 8.3 pounds ready for travel, and the 9TE weighs 7.8 pounds.

Performance aside, these systems, especially the XL, are feature rich. Each is a three-spindle machine with built-in floppy disk and CD-ROM drives. The entry-level unit had a good SVGA screen, but the XL's 14.1-inch XGA panel was marred by a pronounced wobble.

An RCA jack is provided for presentations, and a full complement of ports is on the back of the systems, though port covers do not retract. Both systems have USB ports and CardBus slots. Upgrading each system's memory or hard disk is easy but requires a screwdriver.

Twinhead's technical support is available only on weekdays during extended business hours. If performance is not of paramount importance and you don't mind upgrading drivers, consider the Slimnotes for their low price and reasonable features.—*FJE*

WinBook XLi, WinBook XL 233

WinBook XLi: Pentium II/266, 13.3" TFT, 4.8GB disk, 64MB SDRAM, 7.4 lbs. Battery: 2:18. Winstone 98: 19.1. $3,558 direct.
WinBook XL 233: AMD K6-233, 12.1" DSTN, 2.1GB disk, 32MB EDO DRAM, 7.8 lbs. Battery: 2:29. Winstone 98: 14.7. $1,599 direct. WinBook Corp., 800-651-4518; www.winbook.com. 533 at www.pcmag.com/infolink.

●The WinBook XLi is a competitively priced high-end notebook for users who want a desktop replacement or a presentation system. The WinBook XL 233 is a more modest system aimed at value-conscious buyers. Both systems are good performers but suffer from short battery life. The XL unit's screen was poor, even compared with other dual-scan screens we looked at.

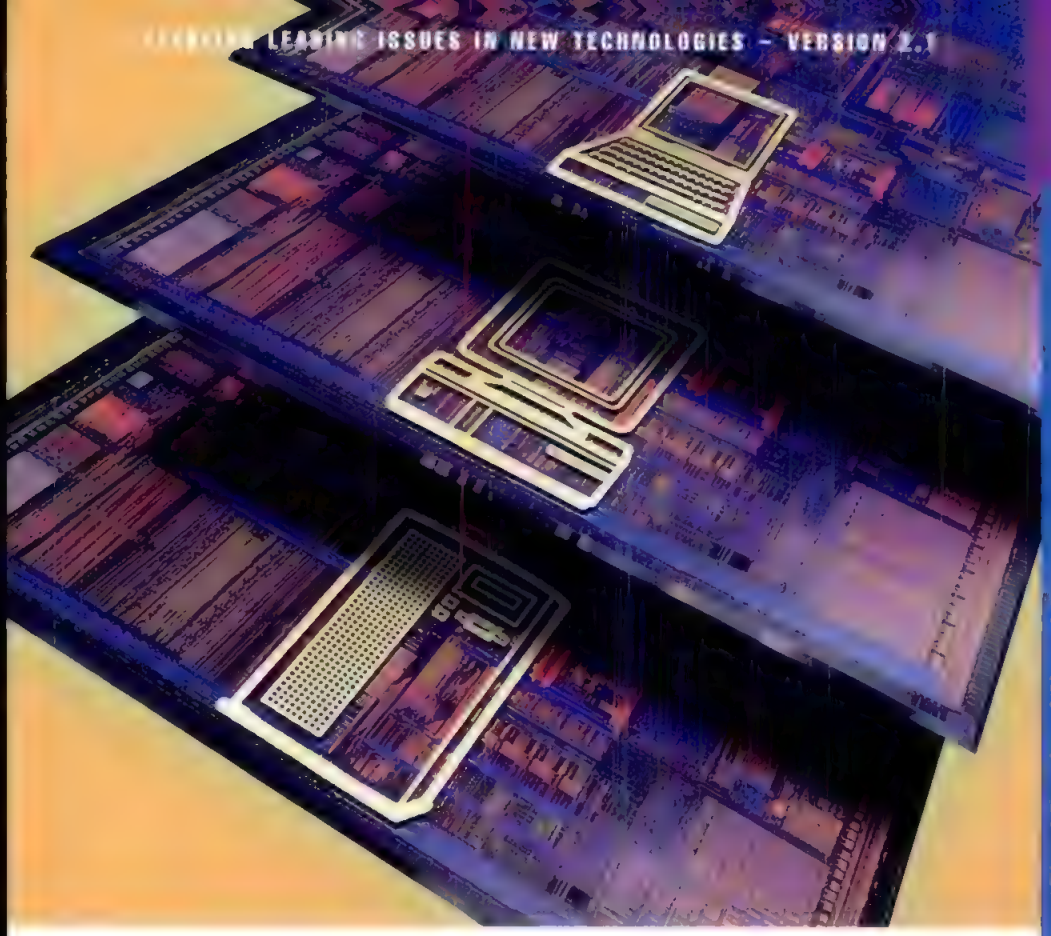
Both are three-spindle systems that can accommodate the CD-ROM, floppy disk drive, and hard disk simultaneously. The XLi has a large hard disk that is upgradable by simply removing a screw from the bottom of the system; this also lets you access the memory. Internal 56-Kbps modems came with both systems; a port replicator ($99), which includes a MIDI jack and a car/airplane adapter ($79.95)—options that can be used with both units.

Although the systems are similar in features, there are some notable exceptions. The 8.6-pound (travel weight) XL has a less efficient nickel hydride battery, which earned it a 2:29 time on our test. The 8.4-pound (travel weight) XLi uses a lithium ion model, which lasted 2:18; the shorter timing was due to the unit's TFT screen, which draws more power than DSTN models, and its power-hungry Pentium II CPU. The XLi system came with a 13.3-inch TFT display and a combination pointing stick/touch pad that was incredibly easy to use and provided good control. The XL came with an adequate touch pad and an SVGA DSTN screen that we found hard to read.

The WinBooks had mostly average scores for their categories on our tests. The XL scored higher than average for its class on our CPU test because of its AMD K6-233; most other units in this category used 233-MHz or slower Pentium MMX.

Technical support is available six days a week. The one-year warranty can be extended to three years for $299 for the XLi and $159 for the XL 233. The WinBook XL is hampered by a poor screen, but its price may catch your eye. The XLi has some very good features and may be worth a second look, although its battery life is short.—*FJE*

WinBook XLi



Intel Tech Buzz

P6 MICROARCHITECTURE

P6 Microarchitecture:
Intel's Foundation for the Enterprise

Intel introduced the P6 microarchitecture in 1995 to build on the already impressive performance of its Pentium® processor. Since then, the company has not only added new performance features to the microarchitecture, but in a series of product introductions this year, has adapted the P6 microarchitecture to create new processors custom-designed for specific segments of the computing marketplace. These processors deliver superior performance and features for their targeted segments, and because of their common core, they also provide businesses with the consistency of a unified architecture for all their business clients and servers.

At the Core: The P6 Microarchitecture

The P6 microarchitecture is made up of three innovative technologies combined to deliver higher levels of performance. All of these key technologies are included in today's Intel® Pentium® II and Pentium® II Xeon™ processors. And many of these technologies are also found in the Intel® Celeron™ processor.

intel

3 Vectors of Performance

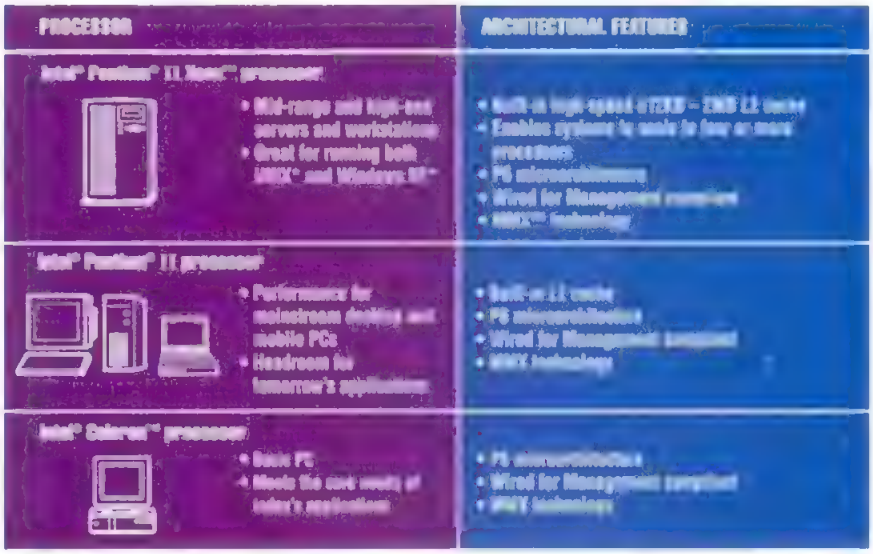
P6 MICROARCHITECTURE

Dual Independent Bus (DIB) Architecture. This high-performance technology combines a dedicated, high-speed L2 cache bus with an advanced system bus. Having two (dual) independent buses means the processor can use both buses and thus get two times more data in and out of the processor than in a single bus architecture. In addition, the L2 cache bus is integrated into the processor package, so it isn't limited in speed by the constraints of motherboard routing. This means the L2 cache bus can run at half the processor core frequency on the Pentium II processor. On the new Pentium II Xeon processor, Intel improves this performance even further by allowing the L2 cache bus to run at the full speed of the processor core.

Dynamic Execution. This innovative combination of three processing techniques—multiple branch prediction, data flow analysis and speculative execution—was first used in the Pentium® Pro processor. Together, these features enable the processor to be more efficient by streamlining and predicting the order of instructions rather than simply processing a list of instructions.

- **Multiple branch prediction** predicts program execution through several branches, accelerating the flow of work to the processor.
- **Data flow analysis** analyzes and schedules instructions so that they are executed in an optimal sequence, independent of the original program order.
- **Speculative execution** increases the rate of execution by looking ahead of the program counter and executing instructions that are likely to be needed.

Intel® MMX™ Technology. Intel developed this set of 57 powerful instructions to manipulate and process video, audio and graphical data more efficiently. These instructions also take full advantage of the efficient processing techniques of Dynamic Execution.



Business Value Across the Board

By deploying systems based on Intel® processors featuring the P6 microarchitecture, businesses can ensure superb performance and features for all their desktops, mobile PCs and servers, while also maintaining a consistent business computing infrastructure that's flexible, manageable and cost effective.

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Whether it's in the office or on the road, one of these 30 data projectors can get your point across. *By Alfred Poor*

Compared with the projectors that we reviewed here just one year ago, the current crop delivers much more for much less: brighter images at higher resolutions in smaller, lighter packages and all at lower prices. For this story, we tested conference-room and portable-class machines from all the major vendors. To be included, a unit had to weigh 20 pounds or less and support at least XGA (1,024-by-768) resolution either natively or through interpolation. We received a total of 30 projectors from 20 companies; two notable vendors, Kodak and Panasonic, were about to release new models but did

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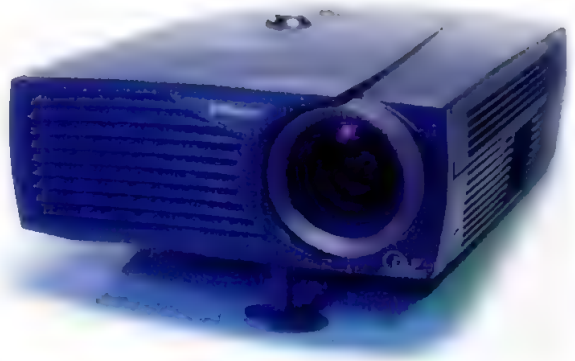
What To Look For in a Projector



Conference Room Projector

Weight: That's not a big issue, but less than 20 pounds is advisable in case you make an occasional road trip.

Resolution: A native XGA (1,024-by-768) unit will let you run training seminars and the like at the resolution used most often on desktop PCs.

Brightness: The brighter the better. Look for at least 450 lumens on our tests.

Inputs: You need at least two of everything, so two presenters can hook up their PCs before a meeting and avoid a shuffle when it's time for the second person to speak.

Sound: A good built-in sound system will save you from having to buy external speakers.

Other helpful touches: Consider a rear/ceiling mount option, a long-range remote, and motorized zoom and focus.

Portable Projector

Weight: Insist on a projector that weighs 10 pounds or less.

Resolution: Super VGA is fine.

Brightness: 300 lumens (on our tests) is fine. Any less and you'll have to dim the lights, inviting your audience to nap.

Inputs: You'll be the only presenter; one input is sufficient.

Sound: That's not as important if you'll be addressing small groups.

Other helpful touches: Consider a remote, easily adjustable feet, and a carrying case that can fit a laptop, too (so your equipment can pass as just one carry-on).

not have units in time for testing.

The product classes we include here represent the two largest segments of a market that can roughly be broken down into three categories:

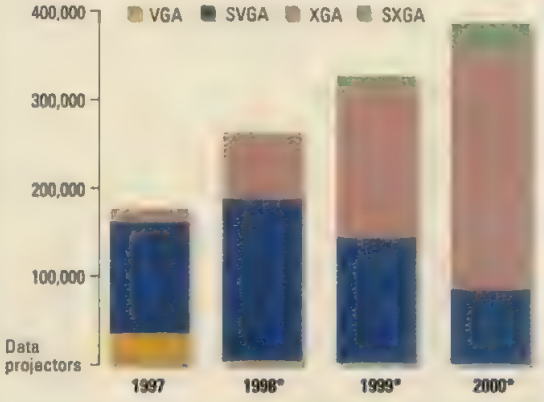
Portable or *personal projectors.* Whereas a year ago, a typical portable projector weighed 15 pounds, now a projector must weigh around 10 pounds or less to fit this category. The six portables we tested weigh less than 10 pounds (three other units weigh 11) and are built as road-going companions for mobile professionals. They generally aren't as bright or feature-rich as their larger counterparts, nor do they need to be: They sacrifice some niceties to shed every pound possible. Projector makers hope to supplant the flip charts and hard-copy handouts used for the millions of sales calls and marketing presentations that take place in the business world every week.

Conference-room projectors. Though still transportable, these units are larger (typically weighing from 10 to 20 pounds), are generally 50 percent to 100 percent brighter than portables (for use in larger rooms), and have handy features such as motorized zoom and focus adjustments. They compete with traditional overhead and slide projectors for presentations and computer-based training. Of the 30 units here, 21 fall into this category.

Fixed-installation projectors. These behemoths (weighing from 50 to hundreds of pounds) are niche products designed for auditoriums, conference centers, and very large classrooms. They generally need trained professionals to set up and adjust them properly, so we don't review any of them here.

Data Projectors: Growing Market, Going Hi-Res

The market for data projectors in the U.S. is small but growing quickly. The big trend is the steady migration to XGA as that resolution becomes the norm in the laptop arena.



* Estimated.

Source: Pacific Media Associates.

WHY THE SUDDEN POPULARITY?

Though self-contained PC projection systems have been available for years, the market has heated up only in the past year or so. Sales in the U.S. were about 175,000 units in 1997, according to Pacific Media Associates, a market research firm based in Mountain View, California. The figure for this year is expected to swell by about 45 percent, to 254,000 units.

Much of this growth can be attributed to better products: In

Editors' Choice

- Portable: In Focus LP420
- Conference room: Epson PowerLite 7300

Projectors have improved dramatically in the past year, and two of the 30 entries we tested stood out as class leaders—one for its portability, the other for its brightness and rich feature set. Several others are worth a close look.

If a projector will be your frequent companion on business trips, you can't beat the In Focus LP420 ($5,000 street), our Editors' Choice among the sub-10-pound portables. Weighing only 6.8 pounds, it's the lightest unit in this roundup. Brightness (417 lumens) and image quality in its native SVGA mode are more than acceptable for use in a medium-size conference room. Granted, the LP420 is not as feature-rich as some competitors (only one set of media jacks, no remote control or zoom), but leaving those extra pounds behind is a trade-off we'll make any day. In this class, we award honorable mentions to the NEC MultiSync LT80 ($5,200 street) and the Proxima UltraLite DS1 ($5,500 street)—both 9.9-pound SVGA units with a good balance of brightness, image quality, and features.

For high-quality multimedia presentations where portability is less of a factor, our Editors' Choice is the Epson PowerLite 7300 ($14,999 list). Thanks to Epson's microlens technology, this XGA unit delivered 984 lumens on our tests—the highest in the roundup by a wide margin. Equipped with Epson's unique serial port connection as well as intuitive user controls, the unit is easy to use and also boasts excellent audio output. As the value buy for those with tighter budget constraints, we recommend the smooth, versatile, and affordable Proxima DP9200 ($6,800 street), which merits an honorable mention.

We found several other conference-room models that provide a fine balance of performance, price, and features. Though they are not quite as good as our Editors' Choice and honorable mention, they are still worth a close look. These include the ASK LCD Impression A4+ ($7,500 street) and A6+ ($10,500 street), the Davis DL450 ($5,500 street), the Epson 5000XB ($8,499 list), the In Focus LP735 ($9,999 list), the NEC MultiSync MT820 ($5,000 street), the Sharp Notevision3 XG-NV3XU ($9,495 list), and the Telex P600 ($7,500 street). A special nod goes to the ViewSonic PJ1000 Office Theater ($7,500 street) for its superior video quality (the best we saw) and to the Toshiba TLP-511A MediaStar ($9,995 list) for its unique document imaging camera, which lets you insert actual paper documents and project them onto the screen as with a standard overhead projector for opaque objects.

years past, projectors weighed 25 pounds or more and cost upwards of $15,000, so they were limited largely to boardrooms and other high-profile settings. Now that units are more portable and affordable (12 in this roundup have street prices of $6,000 or less), companies are finding it feasible to equip more of their conference rooms and staff. Another development is plain old market awareness: More business users are familiar with projectors and recognize the edge a multimedia presentation has over paper or transparencies (or worse, a presentation in which everyone huddles around a laptop screen) when they need to get a point across or make a sale.

The majority of the projectors we tested use active-matrix polysilicon liquid crystal display (LCD) panels to create their images. In most cases, they combine images from three separate panels—one each for producing a red, a green, and a blue image—to create the full-color picture on the screen.

But five projectors here are based on DLP (Digital Light Processing) technology (also called DMD, for Digital Micromirror Device), developed by Texas Instruments. A DLP engine uses a semiconductor chip covered by tiny mirrors that tilt to reflect light toward or away from the screen. There is a single micromirror for each pixel. Until recently, the only way to make a projector using this technology was to use the lamp, panel, and optics provided by TI. This year, however, some manufacturers have developed their own light engines around the TI chip—resulting in a much smaller, lighter, and more compact projector than was possible with the TI design.

www.pcmag.com

Project yourself online for downloadable test images to check out the quality of your own data projector. Also have a look at our online Summary of Features.

DON'T OVEREMPHASIZE BRIGHTNESS

One trend among users has been to focus almost entirely on brightness when choosing a projector. Manufacturers typically specify the light output of their projectors in terms of ANSI lumens. A lumen is a unit of measure that reports the amount of light that a light source casts; this provides a means of comparison independent of image size. The American National Standards Institute (ANSI) has developed a set of standards for measuring projectors' light output, and results from following this method are called *ANSI lumens*. Although the standard outlines the testing process in considerable detail, some subjective judgments are necessary when setting a projector's brightness and contrast, and

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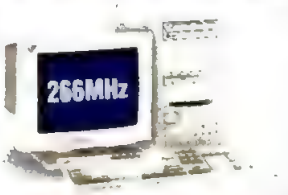

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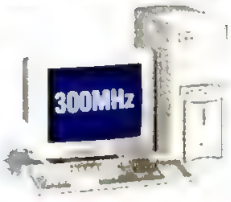

Signet 44300 Multimedia Computer With AMD K6 MMX™ Enhanced Processor: 300MHz

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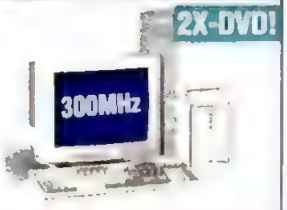

Signet 45300 DVD Multimedia Computer With AMD K6 MMX™ Enhanced Processor: 300MHz

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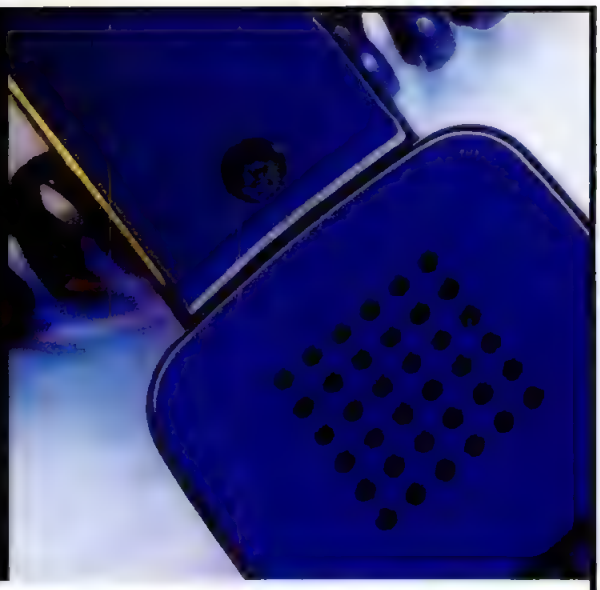

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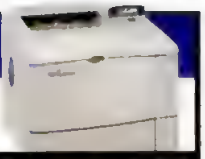

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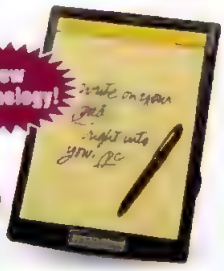

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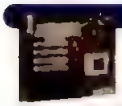

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ViewSonic PJL802 ViewBook	11.0 pounds	800 x 600	Fair	Good	Good	Fair
ViewSonic PJ1000 Office Theater	20.0 pounds	1,024 x 768	Good	Good	Excellent	Good

that can affect the lumen rating.

On our tests, we took a more quality-conscious approach to setting brightness and contrast—favoring adjustments reproducing dark and light shades of colors more accurately than fully cranked brightness, and favoring better contrast ratings (see the performance test section for details). As a result, our tested lumens figures typically are 15 to 25 percent below the manufacturers' ratings but accurately show the relative brightness of projectors in the field.

One problem with measuring brightness is that buyers may overrate the differences among projectors. The perception of light is much like the perception of sound; you should make comparisons on a logarithmic scale. For example, a sound must be ten times as loud as another sound for you to perceive it as twice as loud. Similarly, a projected image must be ten times as bright as another before you will perceive it to be twice as bright. Thus, the difference between a 500- and a 600-lumen projector may be noticeable but not particularly significant.

WEIGHT AND RESOLUTION

So if most of these projectors have equivalent brightness, what should you look for? First and foremost is weight. If a projector will spend most of its time traveling with you, every pound matters. This year, In Focus Systems delivered the 6.8-pound In Focus LP420 (most other portables are over 9 pounds), our Editors' Choice for road warriors. But if a unit will spend most of its time on a cart in your offices, you can disregard weight and concentrate on other features—the number of inputs, sound quality, and so on.

The next major consideration is resolution. For projectors, it has risen steadily, keeping pace with the move in laptop PCs from VGA (640-by-480) to Super VGA (800-by-600) and now to XGA (1,024-by-768). Last year, Super VGA projectors were the best available. This year, nearly half of the projectors that we reviewed have XGA as the native resolution.

Most users today will do fine with Super VGA units. A projector will most often be used with presentation applications such as Microsoft PowerPoint, which do not require high resolutions to convey the relatively low-density information on a slide. Super VGA units cost $2,000 to $3,000 less than their XGA counterparts and are generally brighter, because fewer pixel transistors block the light.

Consider an XGA unit under three conditions: if you need to project from high-resolution applications such as AutoCAD, if you'll use the projector for group computer training (since XGA is now the norm for a Windows desktop), or if you have (or plan to migrate to) an XGA notebook and want a matching projector.

All of the machines in this roundup can interpolate a nonnative resolution and then project an image. So even if your projector has a Super VGA panel, it will be able to interpret and project an XGA or VGA signal. On our tests, however, we found even the best interpolated images to be a compromise; the image was never as good as at the native resolution. But interpolation is important from an ease-of-use standpoint: Most users don't know how (or don't want) to change the VGA or Super VGA output of their laptops. And since you want people to be able to walk up and plug in their notebooks with no muss and no fuss, the projector must be able to synchronize with a range of resolutions.

Rule of thumb: Pick a unit that matches the resolution of the signal you'll use most often. But if you're going to have visiting computers, then interpolation to higher or lower resolutions is essential.

Our Contributors: ALFRED POOR, BRUCE BROWN, and M. DAVID STONE are contributing editors of *PC Magazine*. S. JAE YANG was the labs project leader, and JAMIE M. BSALES was the editor in charge of this story.

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BEYOND THE BASICS

Some manufacturers have incorporated novel technologies to improve their projectors' performance. Most noticeable in this category is the Epson PowerLite 7300, the brightest projector we tested and an Editors' Choice. Active-matrix LCDs rely on small transistors at each cell to turn the cell on and off. These transistors occupy part of the cell's space and block some of the light as it passes through the panel. The PowerLite 7300 panel uses microscopic lenses to focus incoming light onto the portion of each cell that is not blocked—resulting in greater light transmission and efficiency and therefore a brighter image.

The 11-pound ASK LCD Impression A6+ is one of the brightest XGA-resolution projectors we tested.

There are other advances, such as the UHP (Ultra High Performance) lamp, developed by Philips, which maintains a steadier light-output level over the course of its useful life (as many as 6,000 hours). In contrast, standard metal-halide lamps gradually get dimmer with use and may be only half as bright after less than 1,000 hours of use.

You'll also find other handy features, such as the ability to play back a PowerPoint presentation that you've stored on a PC Card flash memory card, without any computer attached to the projector (look to units here from nView, Sanyo, and ViewSonic). The Toshiba unit includes a video camera that lets you project images of pages or even three-dimensional objects, so it doubles as a traditional overhead projector for opaque objects (but not for transparencies).

If you need to display a big picture to make a point with a group of people, either at the home office or on the road, then you're likely to find a suitable choice among these projectors.

ASK LCD Impression A4+, A6+

A4+: 800 x 600; 750 lumens (598 tested); 11.0 lbs.; $7,500 street. A6+: 1,024 x 768; 650 lumens (539 tested); 11.0 lbs.; $10,500 street. Englewood, NJ; 800-275-5231, 201-541-2424; www.asklcd.com. 534 at www.pcmag.com/infolink.

● The ASK LCD Impression A4+ and A6+ offer two of the best combinations of portability and brightness in this roundup. Identical twins but for their resolution capabilities, both deliver image quality that's more than acceptable for 11-pound units. The octopus-style cables of each make setup harder than for the other products we tested, but that's balanced by a manual zoom and focus that adjust smoothly and easily.

With a tested lumens score of 598, the Impression A4+ was the second-brightest Super VGA projector we found—and the brightest unit with a zoom lens. The Impression A6+ posted a lumens score of 539; it was one of the brighter XGA models we tested. Data-image quality for both was good at their native resolutions, and the projectors handled video images particularly well. (For the Impression A4+, we did notice a few faint vertical lines of uneven brightness at the center of the screen.) Unfortunately, these units' audio quality isn't a match for the video. The speakers are loud enough for a moderate-size room but tinny by any measure. Even at moderate volume, the sound is muddy enough so speech is sometimes hard to understand.

For higher resolutions than their native Super VGA or XGA, you can set the units either to compress the image by dropping pixels (which tended to add artifacts in our testing) or to show only as much as fits on-screen at once, letting you pan across. For lower resolutions, you see either a partial screen at the native resolution or a full screen with interpolation (which also introduced artifacts in our testing). Other projectors handle nonnative resolutions more cleanly, but at their native resolutions, both Impressions are hard to beat. *—M. David Stone*

Boxlight BL3750

800 x 600; 750 lumens (626 tested); 12.0 lbs.; $6,000 street. Poulsbo, WA; 800-762-5757; www.boxlight.com. 535 at www.pcmag.com/infolink.

● Boxlight Corp. sources its Boxlight BL3750 from In Focus Systems, and physically, the unit is nearly identical to the In Focus LP725 (also reviewed here). The Boxlight is one of the less expensive models in this roundup, but convergence problems and panel defects detracted from image quality in our testing, as did some color posterizing when we viewed videos.

In our labs, the Boxlight showed good brightness (626 lumens) for a 12-pound unit and was among the best on our Brightness Variance test. On-screen menus are relatively easy to operate, and the Boxlight has a single-cable hub (called the CablePro by Boxlight, the CableWizard by In Focus) that provides convenient and intuitive connections for a computer, mouse, and monitor. The BL3750 is an adequate choice, though we saw better. *—Alfred Poor*

CTX Opto EzPro 600, 700

EzPro 600: 800 x 600; 500 lumens (410 tested); 12 lbs.; $4,500 street. EzPro 700: 800 x 600; 600 lumens (467 tested); 9.7 lbs.; $6,500 street. Sunnyvale, CA; 888-942-2929, 408-541-6060; www.ctxopto.com. 536 at www.pcmag.com/infolink.

● The CTX Opto EzPro 600 falls short of the mark set by other units in its weight class. The manual and quick-start card are not clear enough, the mouse-cable connection takes study to figure out, and on-screen menus use a somewhat confusing combination of Arrow and Enter buttons. Motorized zoom and focus controls tend to overshoot desired settings, and the lack of brightness control limits image adjustments. The bundled stereo sound system

A portable DLP projector, the CTX Opto EzPro 700 is a solid choice for users on the go.

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Optimal Resolution	1280 x 1024 @ 89Hz	1024 x 768 @ 87Hz	1024 x 768 @ 87Hz

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PERFORMANCE TESTS

Data Projectors

Most of the units fell within an acceptable range in terms of brightness and image quality. Not surprisingly, the bulkier conference-room units delivered brighter images than the portables did.

This year's crop of data projectors covers a broad range of sizes, weights, and features. In our labs, we tested the image quality of each, including brightness, contrast, and uniformity—and the results point to some interesting conclusions. Though the Epson PowerLite 7300 is clearly brighter than every one of its competitors, most of these projectors are bright enough to produce a quality image in a well-lit room.

Right or wrong, buyers tend to focus on brightness as the key feature when choosing a projector, and the numbers that manufacturers give out are generally in ANSI lumens. ANSI refers to the American National Standards Institute, which published a document in 1992 outlining proper product-testing procedures ("Data Projection Equipment and Large Screen Data Displays—Test Methods and Performance Characteristics"). Though manufacturers use these guidelines to calculate their brightness figures, we decided not to take their word for it and instead tested them ourselves, using many of the same methods recommended by ANSI.

We used ANSI procedures as a guideline for brightness testing, but our results are consistently lower than what manufacturers claim. One reason for the difference is that our setup procedures were designed to optimize brightness and contrast settings to produce accurate light and dark shades and were thus more demanding than the ANSI protocol. Though the settings sacrificed some brightness for improved image quality, they helped ensure that all of the projectors were compared with each other under the same conditions. For our adjustments, we used target images generated by Sonera Technologies' DisplayMate for Windows (*www.displaymate.com*).

There's more to projector image quality than just brightness, and our tests show that there are some significant differences among the products in this review. Contrast indicates how much difference there is between white and black areas in the image—some light leaks through "black" portions of an LCD projector's image, and some projectors produce a lighter "black" than others. And the uniformity of the brightness is also a factor; some projectors have center "hot spots" that are brighter than the rest of the image, or noticeable shadows in the corners.

◀ The main target screen in DisplayMate tests a number of attributes. White lines reveal any convergence problems; the colored and gray bars show how well the unit handles colors and grayscale. The circles reveal imperfect geometry.

Bold type denotes first place. denotes Editors' Choice	Native Resolution	Lumens
ASK LCD Impression A4+	800 x 600	598
ASK LCD Impression A8+	1,024 x 768	539
Boxlight BL3750	800 x 600	626
CTX Opto EzPro 600	800 x 600	410
CTX Opto EzPro 700	800 x 600	467
Davis DL450	800 x 600	305
EIKI LC-SVGA860	800 x 600	560
EIKI LC-XGA970	1,024 x 768	470
Epson PowerLite 5000XB	800 x 600	550
Epson PowerLite 7000XB	1,024 x 768	456
Epson PowerLite 7300	1,024 x 768	984
In Focus LP420	800 x 600	417
In Focus LP725	800 x 600	715
In Focus LP735	1,024 x 768	603
Lightware MVP800	800 x 600	238
Mitsubishi X100	1,024 x 768	501
NEC MultiSync MT820	800 x 600	475
NEC MultiSync LT80	800 x 600	452
nView L-605-K1	800 x 600	250
Philips ProScreen LC4600B Impact	800 x 600	377
Polaroid Polaview 215	800 x 600	238
Proxima UltraLite DS1	800 x 600	430
Proxima DP9200	1,024 x 768	467
Sanyo PLC-5600N	800 x 600	439
Sharp Notevision3 XG-NV3XU	1,024 x 768	560
Sony VPL-X600U	1,024 x 768	456
Telex P600	1,024 x 768	676
Toshiba TLP-511A MediaStar	1,024 x 768	497
ViewSonic PJL802 ViewBook	800 x 600	351
ViewSonic PJ1000 Office Theater	1,024 x 768	551

BETTER ▶

▲ The Epson PowerLite 7300 scored the highest on this test, with a whopping 984 lumens. In practice, we found that any projector that scored at least 400 lumens was sufficiently bright for most lighted rooms. Those units scoring under 300 lumens (the Lightware MVP800, nView L-605-K1, and Polaroid Polaview 215) will require you to dim or turn off the lights in your conference room.

To perform our contrast measurements, we again followed ANSI procedures. As before, our more stringent brightness and contrast settings may explain why the results differ from most manufacturers' specifications. The DLP projectors demonstrated a commanding advantage on this test. Though a score above 100:1 represents an attractive image, the DLP projectors scored close to 200:1—with the Proxima UltraLite DS1 producing a 201:1 ratio. These higher-contrast images were noticeably better than those produced by the rest of the field, which typically scored closer to 100:1.

Note that on our Brightness Variance test, measuring the uniform brightness of a projected image, it is possible for some images to lack uniformity yet still score well. If areas of different brightness are close together on screen—such as a wavy pattern of light and dark caused by the projector lamp structure or by flaws in the optics—then a lack of uniformity may be quite noticeable to an observer yet not show up in the *(continues)*

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PERFORMANCE TESTS

(continued) measurements. This can happen because our nine measurement points are spread evenly across the screen and may miss the points of maximum or minimum brightness. We noticed this discrepancy with many of the units in the roundup, and we mention it in the reviews when the problem was significant. Still, the uniformity measure is a useful tool for analyzing the screen image as a whole.

No objective measurement can provide a complete picture of a projector's image quality, so our reviewers also spent some quality time with each unit. They used a different series of DisplayMate images to check such factors as stability, convergence (which is critical for three-panel models), and ghosting (where the image from some cells bleeds into adjacent ones).

We viewed most images in the projector's native resolution; since, however, these units can scale to images of higher or lower resolutions, we tested them in their interpolated modes as well. We looked at patterned images and text samples of different sizes to see how much information was lost in the scaling process, and to see if unwanted artifacts were introduced into the image.

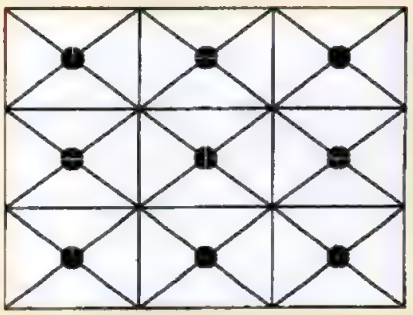
Finally, we connected each of the projectors in the roundup to a quality stereo VHS video cassette player, on which the reviewer watched a specific section of the movie *Twister*. This gave us the opportunity to check for motion and scaling artifacts in the image, as well as to examine the ability of the projector's sound system to handle the movie soundtrack. We listened particularly for distortion at full volume, tonal qualities, and dynamic range (the ability to handle both quiet and loud passages). We discuss specific findings in the individual reviews.—*Analysis written by Alfred Poor*

▲ High scores are best.
▼ Low scores are best.
Bold type denotes first place.
denotes Editors' Choice

	Native Resolution	Contrast Ratio ▲	Brightness Variance ▼
ASK LCD Impression A4+	800 x 600	121:1	1.11
ASK LCD Impression A6+	1,024 x 768	118:1	1.15
Boxlight BL3750	800 x 600	129:1	1.11
CTX Opto EzPro 600	800 x 600	88:1	1.29
CTX Opto EzPro 700	800 x 600	182:1	2.09
Davis DL450	800 x 600	178:1	1.23
EIKI LC-SVGA860	800 x 600	53:1	1.17
EIKI LC-XGA970	1,024 x 768	107:1	1.14
Epson PowerLite 5000XB	800 x 600	98:1	1.12
Epson PowerLite 7000XB	1,024 x 768	87:1	1.13
Epson PowerLite 7300	1,024 x 768	93:1	**1.09**
In Focus LP420	800 x 600	181:1	2.40
In Focus LP725	800 x 600	118:1	1.16
In Focus LP735	1,024 x 768	128:1	1.19
Lightware MVP800	800 x 600	188:1	2.00
Mitsubishi X100	1,024 x 768	119:1	1.10
NEC MultiSync MT820	800 x 600	96:1	1.31
NEC MultiSync LT80	800 x 600	174:1	2.06
nView L-605-K1	800 x 600	95:1	1.15
Philips ProScreen LC4600B Impact	800 x 600	98:1	1.10
Polaroid Polaview 215	800 x 600	89:1	1.15
Proxima UltraLite DS1	800 x 600	**201:1**	2.24
Proxima DP9200	1,024 x 768	102:1	1.14
Sanyo PLC-5600N	800 x 600	98:1	1.17
Sharp Notevision3 XG-NV3XU	1,024 x 768	110:1	1.13
Sony VPL-X600U	1,024 x 768	109:1	**1.09**
Telex P600	1,024 x 768	126:1	1.13
Toshiba TLP-511A MediaStar	1,024 x 768	93:1	1.48
ViewSonic PJL802 ViewBook	800 x 600	97:1	1.21
ViewSonic PJ1000 Office Theater	1,024 x 768	82:1	1.14

▲ Though a score above 100:1 on our Contrast Ratio test represents an attractive image, the DLP projectors scored close to 200:1—with the Proxima UltraLite DS1 producing a 201:1 ratio. The higher-contrast images were noticeably better than those in the rest of the field, which typically scored closer to 100:1.

The Sony VPL-X600U took top honors on our Brightness Variance test, with a remarkably low score of 1.09. Projectors that scored 1.15 or lower generally appeared to have uniform brightness. Some of the smaller projectors, especially the lightweight DLP units (the In Focus LP 420, CTX Opto EzPro 700, NEC MultiSync LT80, and Proxima UltraLite DS1), had scores greater than 2.00, meaning that the brightest point was more than twice as bright as the dimmest point.



◀ We use this standard ANSI test pattern for our Lumens and Brightness Variance tests. We measure the lux falling on the screen at the nine equally spaced spots, and calculate the projector's lumens output and uniformity.

How We Tested

The Lumens test measures the number of lumens cast on-screen by each projector. We define nine equally spaced points on our test screen, then use a light meter to detect the brightness in *lux* (or lumens per square meter) at those points. Our test screen was 1.5 meters wide by 1.125 meters high (1.6875 square meters)—fairly typical for business applications. Therefore, we took the average lux of the nine points and multiplied the result by 1.6875 to generate the lumens score.

For the Contrast Ratio test, we measure light output at 16 points on a checkerboard image made of black and white blocks, then calculate average scores for all the white and all the black squares. We then divide the average white score by the average black score to indicate how much brighter the white blocks are when compared with the black blocks. The result is the contrast ratio. Higher numbers are better, since they represent more dramatic contrast.

For the Brightness Variance test, we use the same nine lux measurements taken for the Lumens test and divide the maximum reading by the minimum reading to give a measure of how uniform the light output is. Lower scores are better, and a perfect score would be 1.0—meaning that the minimum and maximum measurements are the same.

We created the image signals using a Pentium computer with a standard XGA-capable graphics adapter. The room was darkened to eliminate any light from sources other than the projector, and the image was projected onto flat-black paper so that minimal light would be reflected around the room. We took light measurements using a Tektronix J17 read-out base having a J1811 measurement head, with the light sensor held against the target wall and aimed directly at the projector. We measured the amount of light falling on that spot in lux, and took measurements at the points described in the ANSI test protocol. White light measurements were made to the nearest 0.1 lux, and black measurements were made to the nearest 0.01 lux.

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Although dimmer than some units, the Davis DL450 boasts good image quality and excellent audio.

has enough volume but lacks tonal range, especially at lower frequencies. On our tests, the EzPro 600 was not as bright as others in its class, and its contrast was among the worst. Diagonal crosshatch artifacts at object edges marred video images.

The EzPro 700 is an ultraportable DLP projector that's a solid choice for users on the go, but it's not a standout. The documentation is rough, and the cabling arrangements favor use with a laptop. Note that you can use the remote as a mouse and that there are manual focus and zoom controls on the projector itself.

Colors were bright though a bit off (green was too yellow, for example). The projector showed excellent contrast but uneven brightness uniformity. The unit can scale to 1,024-by-768 resolution, and it's one of the best in this roundup at retaining image content after interpolation. Although the cooling fan can drown out quiet sounds, the speakers permit high volume with good tonal control.—*AP*

Davis DL450

800 x 600; 500 lumens (305 tested); 9.9 lbs.; $5,999 list. San Jose, CA; 888-798-9998, 408-487-3787; www.davisna.com. 537 at www.pcmag.com/infolink.

● This clever projector combines an attractive price with a weight of less than 10 pounds, good to excellent image quality (at its native Super VGA resolution), and better-than-average sound quality. The Davis DL450, from Davis North America, is easy to recommend, with two qualifications: Performance is generally sub-par at interpolated resolutions, and it's a somewhat dim unit that works much better with the lights turned off.

On our tests, the Davis showed excellent contrast and good brightness uniformity. But we measured its brightness at just 305 lumens, and it was noticeably dimmer than most units in this roundup. The unit also doesn't do well interpolating XGA data; images showed too much flicker and distortion for comfortable viewing.

The projector puts out plenty of sound with its 10-watt amplifier, and motorized zoom and focus controls make quick adjustments easy. The Davis is a good choice for presenters on the road, but be prepared to dim those lights.—*Bruce Brown*

EIKI LC-SVGA860, LC-XGA970

LC-SVGA860: 832 x 624; 700 lumens (560 tested); 14.3 lbs.; $6,995 list. LC-XGA970: 1,024 x 768; 550 lumens (470 tested); 14.3 lbs.; $9,995 list. Lake Forest, CA; 800-322-3454, 714-457-0200; www.eiki.com. 538 at www.pcmag.com/infolink.

● Eiki International's EIKI LC-SVGA860 is a solid projector that consistently produces bright, high-quality images, though its size and weight make it a little less portable than some of the competition. The native resolution of 832 by 624 pixels is the standard for Macintosh PCs; with a PC, the unit uses 800 by 600 of those pixels to deliver an image that is remarkably free of streaking and ghosting. On our tests, it managed a 560-lumen measurement, which only two other Super VGA projectors were able to beat.

At lower resolutions, you can choose to scale the image to full screen or view it in a smaller window. Either choice yields a soft-focus effect, with readable text but with artifacts in graphic fills. At higher resolutions, you can compress the image—adding artifacts—or show only part of it and pan to see the rest. Easy setup, motorized zoom and focus, and easy-to-understand menus top off this highly recommendable package.

Essentially a higher-resolution version of the Super VGA model, the LC-XGA970 doesn't offer comparably ghost-free and streak-free images, but it has virtually no flaws worth mentioning at the native 1,024-by-768 resolution. The 470-lumen score posted in our labs means that there is enough brightness to produce excellent images in a well-lit room.—*MDS*

Epson PowerLite 5000XB, 7000XB, 7300

5000XB: 800 x 600; 750 lumens (550 tested); 14.5 lbs.; $8,499 list. 7000XB: 1,024 x 768; 650 lumens (455 tested); 14.7 lbs.; $11,999 list. 7300: 1,024 x 768; 1,200 lumens (984 tested); 13.8 lbs.; $14,999 list. Torrance, CA; 800-463-7766, 310-782-0770; www.epson.com. 539 at www.pcmag.com/infolink.

PC MAGAZINE EDITORS' CHOICE

In the new order of sub-10-pound projectors, the Epson PowerLite 5000XB is a bit too heavy to be a go-everywhere unit, but its bright, uniform images and flexible connections make for good office presentations. A serial connection (unique to this roundup) lets you configure and adjust the projector using a Windows utility, which is simpler than the typical on-screen menu system. The utility lets you customize the projector's start-up screen with your company's logo or any bitmap image.

In our testing, data-image quality in

The intuitive Epson PowerLite 5000XB and 7300 produce bright and uniform images and excellent audio. The PowerLite 7300 earns our Editors' Choice for conference-room use.

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the projector's native Super VGA mode was fine. Though compression for higher resolutions is a compromise, the PowerLite 5000XB was still one of the best units at creating a legible interpolated image. Noticeable cross-hatching on some objects and blotchy skin tones marred Super VGA video images, making this projector better suited for computer-based data displays than for video.

The Epson PowerLite 7000XB is the fraternal twin of the 5000XB—including the same remote, cabling, connections, and Windows-based configuration utility. The difference is its higher native resolution, which produced slightly less brightness with a lower contrast ratio on our tests. As with the PowerLite 5000XB, this unit's manual zoom and focus features provide a comfortable range of image sizes and distances that should work well for most meeting-room configurations. And like the PowerLite 5000XB, the PowerLite 7000XB includes Spatializer circuitry, delivering expanded stereo sound with more separation than you'd expect from two small speakers so close together. The projector did relatively well with compressed and expanded resolutions on our tests, but on video playback, it was among the worst for motion artifacts and other flaws.

The Epson PowerLite 7300 shares many of the other two models' features, but it stands out in two ways: It's the brightest projector in this roundup, and it's the most expensive. The brightness comes from the use of microlenses behind the LCD panels, which focus the light from the lamp through the LCD cells so that the active-matrix transistors block less light. This results in a uniform image twice as bright as the average for this group.

Manual zoom and focus controls make setup easy, though this unit's optics have a longer throw, so the projector needs to be further from the screen than some of the others we tested. One complaint: Video playback was a bit flawed, with cross-hatch patterns on the edges of some objects and posterizing of skin tones. Still, if you need to get your point across to a large group or in a brightly lit setting, this sub-15-pound unit is the one to beat.—*AP*

In Focus LP420, LP725, LP735

LP420: 800 x 600; 500 lumens (417 tested); 6.8 lbs.; $5,000 street. LP725: 800 x 600; 750 lumens (715 tested); 12 lbs.; $8,499 list. LP735: 1,024 x 768; 650 lumens (603 tested); 12.0 lbs.; $9,999 list. Wilsonville, OR; 800-294-6400, 503-685-8888; www.infocus.com. 540 at www.pcmag.com/infolink.

PC MAGAZINE EDITORS' CHOICE

The In Focus LP420, from In Focus Systems, packs what a road-going professional needs into a bright, ultralight, affordable package, and it's our Editors' Choice for mobile professionals. At 6.8 pounds, it's the lightest projector here, so flaws are easy to forgive. Based on Texas Instruments' DLP engine, it produced an acceptably bright image (417 lumens) and an outstanding contrast ratio on our tests. The LP420 also did excellently with video. In the loss-

The In Focus LP725 is a clever compromise between a portable and a conference-room projector.

es column, uneven illumination resulted in the worst Brightness Variance score of any projector in this roundup.

As with all three In Focus models, the printed manual and quick-start reference card also come in Adobe Acrobat format on a CD-ROM, for easy reference when traveling. But there is no remote control (one is available for $70 list); also, since this model has a manual focus but no zoom, you must move the projector to change image size. These shortcomings are forgivable when weight matters more than extras. The bottom line? This true portable performs at a reasonable price.

At 12 pounds, the In Focus LP725 walks the line between a portable and a conference-room unit. Cable connections are easy with the CableWizard, a discus-shaped external pod that puts all connections right next to the computer. The LP725 delivers excellent color for computer images, though there was slight posterization on video in our tests. Interpolated resolutions had great information loss, and you should avoid them with this projector. The unit is best suited for data projection at its native Super VGA.

The LP735 is the XGA version of the LP725, with the same on-screen menus and CableWizard connection convenience. It posted similar brightness and contrast scores. Manual zoom and focus let you easily adjust the image for individual settings. Expanded-resolution images were adequate in our tests, but compressed resolutions had significant information loss. Video was good aside from some mild cross-hatch artifacts. The LP735 is a satisfactory XGA projector.—*AP*

Lightware MVP800

800 x 600; 350 lumens (238 tested); 9.5 lbs.; $4,000 street. Beaverton, OR; 800-445-9396, 503-641-7873; www.lightware.com. 541 at www.pcmag.com/infolink.

● The Lightware MVP800 is worth considering only if your budget won't support anything more expensive; any other projector in this roundup will outperform it. Lightware helped establish the sub-10-pound projector category two years ago with the standout VP800 unit. Unfortunately, the market has advanced rapid-

Dimmer than other units, the 9.5-pound Lightware MVP800 is a disappointment.

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SUMMARY OF FEATURES

Data Projectors

■ YES ■ NO □ OPTIONAL
Products listed in review order

	ASK LCD Impression A4+	ASK LCD Impression A6+	Boxlight BL3750	CTX Opto EzPro 600	CTX Opto EzPro 700	Davis DL450
Price	$7,500 street	$10,500 street	$6,000 street	$4,500 street	$6,500 street	$5,999 list
Dimensions (HWD, in inches)	5.9 x 9.8 x 11.6	5.9 x 9.8 x 11.6	11.7 x 15.3 x 8.0	5.9 x 9.8 x 15.7	4.7 x 9.3 x 12.8	5.1 x 13.2 x 8.9
Weight (pounds)	11.0	11.0	12.0	12.0	9.7	9.9
Soft case/hard case (list price)	Included / N/A	Included / N/A	$100 / $300	Included / $400	Included / $400	Included / N/A
Engine type/native resolution	LCD / 800 x 600	LCD / 1,024 x 768	LCD / 800 x 600	LCD / 800 x 600	DLP / 800 x 600	DLP / 800 x 600
Highest interpolated resolution	1,152 x 870	1,280 x 1,024	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
Lamp type/rated ANSI lumens	metal halide/750	metal halide/650	UHE/750	metal halide/550	metal halide/600	UHP/500
Rated hours/Replacement cost	2,500 / $395	2,500 / $395	2,000 / $595	1,000 / $395	1,000 / $399	2,000 / $424
Minimum/maximum throw	3 feet/32 feet	3 feet/32 feet	4 feet/40 feet	3.6 feet/76 feet	3.9 feet/39 feet	5 feet/17 feet
Minimum/maximum image size (diagonal)	2 feet/30 feet	2 feet/30 feet	2.4 feet/36 feet	1.6 feet/53 feet	2 feet/25 feet	2 feet/14 feet
Zoom lens	Manual	Manual	Manual	Power	Manual	Power
Electronic zoom	■	■	■	■	■	■
Keystone adjustment/Freeze frame	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Remote control/Lighted keypad on remote	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Number of speakers (Watts per channel)	4 (1)	4 (1)	1 (3)	2 (3)	1 (1)	1 (10)
RGB inputs	2	2	1	1	1	3
Video inputs	S-video, composite	S-video, composite	S-video, composite	S-video, composite	S-video, composite	S-video, composite
Video standards supported:						
NTSC/NTSC 4.3/SECAM	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
PAL/PAL-M/PAL-N	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Other inputs	Mouse, audio	Mouse, audio	Audio	Audio	Audio	Audio, EVC
Connector for external monitor	■	■	■	■	■	■
Rear projection/Ceiling mount capability	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Warranty (parts and labor)	2 years	2 years	1 year	2 years	2 years	1 year
Quick-exchange program under warranty	Next business day	Next business day	None	24 hours	24 hours	48 hours
Toll-free technical support included	■	■	■	■	■	■
Technical-support hours (eastern time)	8:30–6:30 M–F	8:30–6:30 M–F	9:30–8:00 M–F	11:00–9:00 M–F	11:00–9:00 M–F	8:00–8:00 M–F
Web address	*www.asklcd.com*	*www.asklcd.com*	*www.boxlight.com*	*www.ctxopto.com*	*www.ctxopto.com*	*www.davisna.com*

N/A: Not applicable—The projector does not have this feature.

ly in terms of brightness and image quality, and the MVP800 (which replaces the older model's halogen bulb with a brighter metal-halide lamp) has fallen behind the pack.

At just 238 lumens on our tests, the projector's screen image was noticeably dimmer than those of competitors, and the clever unfolding case design is more susceptible to dust. The projector also had many noticeable pixel defects in our testing, and light leaking out of it detracted from the image on-screen. Interpolated-resolution images were poor, with much of the information lost and the sound system weak.

In the MVP800's favor, the manual focus and manual keystone adjustments work well, and you can connect both a physical mouse and a remote connection to your computer at the same time, which is convenient.—*AP*

Mitsubishi X100

1,024 x 768; 600 lumens (501 tested); 21 lbs.; $7,500 street. Cypress, CA; 800-843-2515; www.mitsubishi-display.com. 542 at www.pcmag.com/infolink.

● Although the Mitsubishi X100 delivers acceptable brightness and image quality, it comes up short on ease of use. At 21 pounds, it's more luggable than portable, but the built-in PC Card reader lets you run a presentation without your notebook PC, so you can leave the laptop behind.

In our testing, the image had no noteworthy quality problems at the native XGA resolution. The unit's interpolation algorithm for higher resolutions remaps pixels rather than simply dropping them, an approach that minimizes artifacts yet results in a soft-focus effect. At 501 lumens on our tests, brightness was more than adequate.

The need to install a mouse driver, though, complicates setup. More bothersome is the so-called air mouse, which moves the cursor across the screen when you move the remote through space. This is strictly a gee-whiz feature, one that does not work well; we were constantly overshooting our target or repeating motions to get the cursor to react. Other advanced features are potentially much more useful, though somewhat hidden in the menus: digital magnification and the ability to see images from two sources at once. Still, you can do better with other units here.—*MDS*

NEC MultiSync LT80, MT820

LT80: 800 x 600; 600 lumens (452 tested); 9.9 lbs.; $6,995 list. MT820: 800 x 600; 700 lumens (475 tested); 15.5 lbs.; $7,499 list. Itasca, IL; 800-632-4636, 630-467-5000; www.nec.com. 543 at www.pcmag.com/infolink.

● The NEC MultiSync LT80 combines good portability with better-than-average image quality in an affordable package.

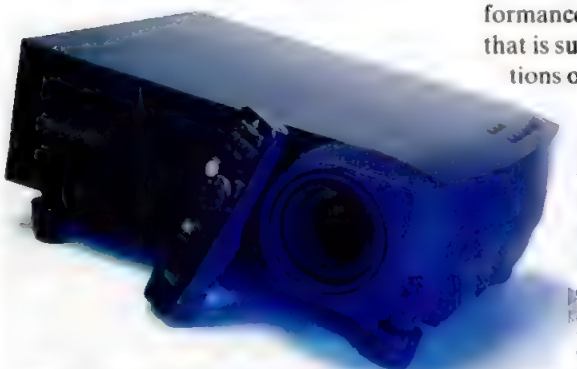
See **www.pcmag.com** for interactive views

Continues

	EIKI LC-SVGA800	EIKI LC-XGA970	Epson PowerLite 5000XB	Epson PowerLite 7000XB	Epson PowerLite 7300	In Focus LP420	In Focus LP725	In Focus LP735	Lightware MVP800
	$6,995 list	$9,995 list	$8,499 list	$11,999 list	$14,999 list	$5,000 street	$8,499 list	$9,999 list	$4,000 street
	6.3 x 10.3 x 15.9	6.3 x 10.3 x 15.9	6.3 x 9.7 x 15.0	6.3 x 9.7 x 15.0	5.1 x 11.8 x 14.3	3.9 x 9.0 x 12.0	6.0 x 11.7 x 15.3	6.0 x 11.7 x 15.3	6.4 x 10.2 x 12.5
	14.3	14.3	14.5	14.7	13.8	6.8	12.0	12.0	9.5
	$170 / $400	$170 / $400	$129 / $249	$129 / $249	$129 / $249	Included / $325	$100 / $299	$100 / $299	Included / $300
	LCD / 832 x 624	LCD / 1,024 x 768	LCD / 800 x 600	LCD / 1,024 x 768	LCD / 1,024 x 768	DLP / 800 x 600	LCD / 800 x 600	LCD / 1,024 x 768	LCD / 800 x 600
	1,024 x 768	1,024 x 768	1,024 x 768	1,280 x 1,024	1,280 x 1,024	1,024 x 768	1,024 x 768	1,280 x 1,024	1,024 x 768
	UHP/700	UHP/550	UHP/750	UHE/650	UHE/1,200	metal halide/500	UHE/750	metal halide/650	metal halide/350
	4,000 / $380	4,000 / $380	2,000 / $500	2,000 / $500	2,000 / $700	1,000 / $395	2,000 / $472	2,000 / $395	500 / $299
	1.6 feet/33 feet	3.6 feet/75 feet	3.3 feet/33 feet	3.3 feet/33 feet	3.9 feet/54 feet	5 feet/18 feet	5 feet/18 feet	5 feet/18 feet	4 feet/Not rated
	1.6 feet/33 feet	1.6 feet/33 feet	2 feet/25 feet	2 feet/25 feet	2 feet/25 feet	4.3 feet/15 feet	3 feet/14 feet	3 feet/14 feet	3.8 feet/Not rated
	Power	Power	Manual	Manual	Manual	N/A	Manual	Manual	N/A
	■	■	■	■	■	■	■	■	■
	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
	■ ■	■ ■	■ ■	■ ■	■ ■	□ ($70) ■	■ ■	■ ■	■ ■
	2 (2)	2 (2)	2 (2)	2 (2)	2 (3)	1 (1)	1 (3)	1 (3)	2 (3)
	2	2	2	2	2	1	1	1	1
	S-video, composite	S-video, composite	S-video, composite	S-video, composite	S-video, composite	S-video, composite	S-video, composite	S-video, composite	S-video, composite
	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
	Audio	Audio	Audio	Audio	Audio	Audio	Audio	Audio	Audio
	■	■	■	■	■	■	■	■	■
	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
	3 years	3 years	1 year	1 year	1 year	1 year	1 year	1 year	1 year
	None	None	Next business day	Next business day	Next business day	None	None	None	Optional
	■	■	■	■	■	■	■	■	■
	9:30–6:30 M–F	9:30–6:30 M–F	9:00–9:00 M–F	9:00–9:00 M–F	9:00–9:00 M–F	24 hours, 7 days	24 hours, 7 days	24 hours, 7 days	9:00–8:00 M–F
	www.eiki.com	www.eiki.com	www.epson.com	www.epson.com	www.epson.com	www.infocus.com	www.infocus.com	www.infocus.com	www.lightware.com

This projector is worth a close look. In native mode, quality for both data and video was excellent in our testing. Even interpolated data images were good enough to be used in presentations. And at 452 lumens, brightness was good for a sub-10-pound unit.

This projector is also great for new users, thanks to its helpful Introductory Video and the Quick Connect Guide, a well-organized, thorough manual. One drawback is that because of the limited audio controls and speaker output, external amplified speakers are necessary for music or high-quality audio. Still, with its fairly light weight and good performance, the LT80 is a versatile system that is suitable for a variety of presentations on the road.



With excellent images and motorized controls, the 15.5-pound NEC MultiSync MT820 is a fine choice.

At a little more than 15 pounds, the NEC MultiSync MT820 is better suited for shuttling among conference rooms and just the occasional road trip—particularly if you add external amplified speakers to pump up its low-powered audio components. With top-quality images in both data and video modes, the jump to 1,024-by-768 interpolated resolution had almost no cost in image quality. And added conveniences such as motorized zoom and contrast, infrared remote sensors on all four sides of the projector, and a built-in laser pointer on the remote control add up to a versatile and recommendable presentation system.—*BB*

nView L-605-K1

800 x 600; 400 lumens (250 tested); 12 lbs.; $4,200 street. Newport News, VA; 800-736-8439, 757-873-1354; www.nview.com. 544 at pcmag.com/infolink.

● A close cousin to the Polaroid Polaview 215 and the ViewSonic PJL802 ViewBook, the nView L-605-K1, from nView Corp., is a respectable choice for presentations on the go. Its main draw is the PC Card slot, which lets you store and run your presentation from a flash memory card—no need to tote your notebook to each meeting. Image quality is acceptable

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- 2MB Video RAM
- Stereo Speakers and Sound Blaster Support
- Windows 95 and Lotus Smart Suite
- Lithium-Ion Battery
- UltraBay Flexibility
- 8X CD-ROM Drive
- 3.5" Floppy Drive
- 28.8 Modem/Fax
- Infrared Ports
- Ethernet Compatible
- 7.7 Pounds, 2.2" Thin
- 3-Year Warranty

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ThinkPad 765L

- Similar to 765D, without CD-ROM or Modem

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- 800 x 600 Resolution
- 1.125MB Video DRAM
- 256KB L2 cache
- 20X CD-ROM
- Lithium-Ion Battery
- 7 Pounds, 2.4" Thin
- Lotus Smart Suite, Windows 95
- One Year Warranty

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ThinkPad 600

Incredibly thin and light, the ThinkPad 600 is big in all the right places, like speed, capability and screen size.

- Intel® Mobile Pentium® II Processor with MMX Technology, 233 MHz
- 32 MB RAM (288MB max.)
- 3.2GB Hard Drive
- 13.3" TFT XGA Color Display
- 1024 x 768 Resolution
- 2MB Video RAM
- 512KB L2 cache
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- Three Year Warranty

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SUMMARY OF FEATURES:

Data Projectors

■ YES ▩ NO □ OPTIONAL
Products listed in review order

	Mitsubishi X100	NEC MultiSync MT820	NEC MultiSync LT80	nView L-605-K1	Philips ProScreen LC4600B Impact	Polaroid Polaview 215
Price	$7,500 street	$5,000 street	$5,200 street	$4,200 street	$4,900 street	$3,850 street
Dimensions (HWD, in inches)	6.3 x 13.0 x 17.3	5.7 x 15.6 x 12.6	4.8 x 9.8 x 12.8	12.8 x 9.4 x 5.9	6.5 x 13.0 x 13.0	9.6 x 8.0 x 13.0
Weight (pounds)	21.0	15.5	9.9	12.0	17.5	12.6
Soft case/hard case (list price)	$230 / $490	$220 / $350	Included / $350	$180 / N/A	$130 / $550	$290 / $400
Engine type/native resolution	LCD / 1,024 x 768	LCD / 800 x 600	DLP / 800 x 600	LCD / 800 x 600	LCD / 800 x 600	LCD / 800 x 600
Highest interpolated resolution	1,280 x 1,024	1,024 x 768	1,024 x 768	1,024 x 768	1,280 x 1,024	1,024 x 768
Lamp type/rated ANSI lumens	metal halide/600	metal halide/700	metal halide/600	metal halide/400	UHP/650	metal halide/400
Rated hours/Replacement cost	1,300 / $499	2,000 / $350	1,000 / $399	1,100 / $350	4,000 / $450	1,100 / $499
Minimum/maximum throw	3 feet /39 feet	3.3 feet/39 feet	3.9 feet/40 feet	3 feet/52 feet	1.9 feet/66 feet	3.2 feet/52 feet
Minimum/maximum image size (diagonal)	1.6 feet/25 feet	1.6 feet/36 feet	2 feet/36 feet	1.6 feet/25 feet	.75 feet/43 feet	1 foot/15 feet
Zoom lens	Power	Power	Manual	Manual	Manual	Manual
Electronic zoom	■	■	■	■	■	■
Keystone adjustment/Freeze frame	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Remote control/Lighted keypad on remote	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Number of speakers (Watts per channel)	2 (1)	2 (1)	1 (1)	1 (1.5)	6 (1)	2 (1.5)
RGB inputs	2	2	1	1	2	1
Video inputs	S-video, composite	S-video, composite	S-video, composite	S-video, composite	S-video, composite	S-video, composite
Video standards supported:						
NTSC/NTSC 4.3/SECAM	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
PAL/PAL-M/PAL-N	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Other inputs	Audio (2)	Audio	Audio	PC Card Type II, RGBN	None	PC Card Type II
Connector for external monitor	■	■	■	■	■	■
Rear projection/Ceiling mount capability	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Warranty (parts and labor)	3 years	1 year	1 year	1 year	2 years	1 year
Quick-exchange program under warranty	Next business day	72 hours	72 hours	24 hours	24 hours	None
Toll-free technical support included	■	■	■	■	■	■
Technical-support hours (eastern time)	8:00–8:00 M–F	8:00 A.M.–8:30 P.M. M–F	8:00 A.M.–8:30 P.M. M–F	8:00–8:00 M–F	8:00–8:00 M–F	8:00–5:00 M–F
Web address	*www.mitsubishi-display.com*	*www.nec.com*	*www.nec.com*	*www.nview.com*	*www.philipslcd.com*	*www.polaroid.com*

N/A: Not applicable—The projector does not have this feature.

for most uses. Other than some slight flickering on a few pattern fills, there are no image-quality problems worth mentioning at the native 800-by-600 resolution. At lower resolutions, you can either scale to full-screen or show a partial screen. With higher resolutions, the only choice is to compress the image to full-screen. However, interpolated images are more readable than they are on many other projectors, though there are still some artifacts. One drawback: The 250-lumen score is one of the lowest posted in this roundup, so the projector is most at home in a dim room.

Ease of use is a mixed bag, with well-designed menus and easy cable setup complicated by the need to install a driver to control your mouse from the remote. All told, however, this is an attractive projector for portable presentations, at an attractive price.—*MDS*

Philips ProScreen LC4600B Impact

800 x 600; 650 lumens (377 tested); 17.5 lbs.; $4,900 street. Atlanta; 800-504-9978; www.philipslcd.com. 545 at www.pcmag.com/infolink.

● This projector boasts reasonably good image quality, acceptable brightness, and high-quality audio at an attractive price. What the unit loses in portability (at 17.5 pounds) it makes up for in ease of setup, well-designed menus, and smoothly adjustable manual focus and zoom. You can find a lighter, brighter projector, but the Philips ProScreen LC4600B Impact has a solid mix of features, given its price.

The tested 377-lumen output is low for a projector of this weight, but the unit was bright enough for easy viewing under lab conditions in a normally lit room. At the native Super VGA resolution, images showed no problems worth mentioning. Lower resolutions showed a slightly smudged effect, like the appearance of an overexposed

The affordable Philips ProScreen LC4600B Impact has a solid mix of features.

See **www.pcmag.com** for interactive views

Proxima UltraLite DS1	Proxima DP9200	Sanyo PLC-5600N	Sharp Notevision3 XG-NV3XU	Sony VPL-X600U	Telex P50E	Toshiba TLP-511A MediaStar	ViewSonic PJL802 ViewBook	ViewSonic PJ1006 Office Theater
$5,500 street	$6,800 street	$7,200 street	$9,495 list	$9,990 list	$7,500 street	$9,995 list	$4,300 street	$7,500 street
4.7 x 9.2 x 12.8	10.8 x 15.6 x 6.5	8.3 x 10.2 x 15.4	5.4 x 10.3 x 13.0	5.4 x 13.4 x 12.7	6.0 x 14.75 x 11.5	5.0 x 13.4 x 14.3	9.5 x 5.9 x 12.8	15.9 x 6.4 x 12.3
9.9	14.1	13.0	14.6	12.8	15.0	17.6	11.0	20.0
$300 / $400	$370 / $450	$150 / $330	$95 / $230	$200 / $474	$200 / N/A	$195 / $495	Included / $300	Included / $300
DLP / 800 x 600	LCD / 1,024 x 768	LCD / 800 x 600	LCD / 1,024 x 768	LCD / 1,024 x 768	LCD / 1,024 x 768	LCD / 1,024 x 768	LCD / 800 x 600	LCD / 1,024 x 768
1,024 x 768	1,280 x 1,024	1,024 x 768	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,024 x 768	1,280 x 1,024
metal halide/600	metal halide/500	UHP/700	UHP/600	UHP/600	UHP/650	UHP/700	metal halide/400	metal halide/600
1,000 / $399	2,000 / $399	2,000 / $580	2,000 / $453	2,000 / $465	2,000 / $700	2,000 / $385	1,100 / $359	1,500 / $369
4 feet/39 feet	3.3 feet/92 feet	3.6 feet/47 feet	4.6 feet/57 feet	5 feet/48 feet	3 feet/40 feet	3.5 feet/39 feet	3.2 feet/53 feet	4 feet/56 feet
2 feet/25 feet	1.7 feet/53 feet	1.6 feet//33 feet	3.3 feet/25 feet	3.3 feet/25 feet	1.6 feet/25 feet	1.8 feet/25 feet	3.3 feet/53 feet	4 feet/56 feet
Manual	Power	Power	Manual	Manual	Power	Manual	Manual	Power
■	■	■	■	■	■	■	■	■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
1 (2)	2 (2)	2 (2)	2 (2)	3 (1.5)	2 (3)	1 (1.5)	1 (1.5)	2 (2)
1	2	2	2	2	2	1	1	2
S-video, composite	S-video, 2/video	S-video, composite	S-video, composite	S-video, composite	S-video, composite	S-video, composite	S-video, composite	S-video, composite
■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Audio	None	Mouse, audio	Audio	Mouse (2), audio	Audio	Audio, microphone	PC Card Type II	Audio
■	■	■	■	■	■	■	■	■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
1 year	1 year	2 years	3 years	3 years	1 year	2 years	3 years	3 years
Optional	Optional	None	None	None	None	Optional	48 hours	48 hours
■	■	■	■	■	■	■	■	■
8:00–8:00 M–F	8:00–8:00 M–F	11:30–10:00 M–F	8:00–6:00 M–F	8:15 A.M.–9:00 P.M. M–F	9:00–8:00 M–F	9:00–8:00 M–Sat.	8:00–5:00 M–F	8:00–5:00 M–F
www.proxima.com	*www.proxima.com*	*www.sanyolcd.com*	*www.sharp-usa.com*	*www.sony.com/professional*	*www.telex.com*	*www.toshiba.com/tacp*	*www.viewsonic.com*	*www.viewsonic.com*

photo, but text was still highly readable. With higher resolutions, small text was harder to read than with some other units, and graphics showed lots of artifacts.

Unlike many projectors here, this one has strong sound quality—with enough volume to fill a large conference room. Image quality for video varies greatly, depending on the source. On our tests, ghost images repeatedly flashed on-screen with one VHS tape, but we saw only artifacts (such as aliasing in straight lines) with another. Neither problem occurred with live video or a DVD source.—*MDS*

Polaroid Polaview 215

800 x 600; 400 lumens (238 tested); 12.6 lbs.; $3,850 street. Cambridge, MA; 800-816-2611, ext. 970, 716-256-4436, ext. 970; www.polaroid.com. 546 at www.pcmag.com/infolink.

● The Polaroid Polaview 215 is a relatively inexpensive but otherwise unremarkable projector. It falls in the middle range for weight among the tested units. Disappointing test scores for brightness (238 lumens) and contrast were borne out by a noticeable dimness in both data and video modes. In native mode, images were generally good (though we noted some minor streaking), but in high-resolution interpolated mode, we found it difficult to hold a steady image.

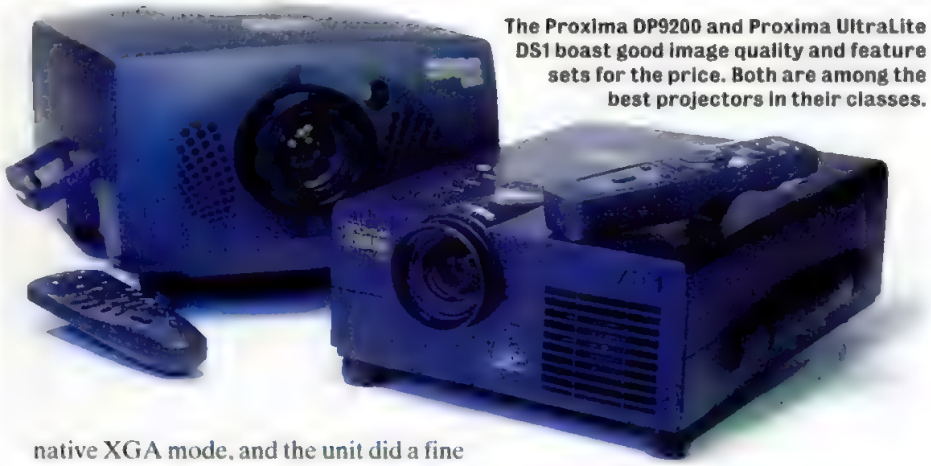
The most notable feature is a PC Card slot, which lets you run the projector from a flash memory card without an attached laptop. Other features on the PolaView are sub-par. The remote pointer works as a mouse but only if you load PC software first; the extensive on-screen controls are not as intuitive as on many other units; and the audio output is weak. In sum, you can do better elsewhere—for example, with a product like the ViewSonic PJL802 ViewBook, which shares the Polaview's design.—*BB*

Proxima DP9200, UltraLite DS1

DP9200: 1,024 x 768; 500 lumens (467 tested); 14.1 lbs.; $6,800 street. UltraLite DS1: 800 x 600; 600 lumens (430 tested); 9.9 lbs.; $5,500 street. San Diego; 800-447-7692, 619-457-5500; www.proxima.com. 547 at www.pcmag.com/infolink.

● If you want a high-end projector for the office and the road, the Proxima DP9200, from Proxima Corp., is the projector for you. It delivers great performance at its XGA resolution and good image quality at Super VGA, fully motorized controls, and very good audio output power and quality at a relative bargain. Although the extensive on-screen menus will send you to the manual at first, the smooth mouse control and multiple infrared receivers will ease operation of the unit.

Although the DP9200's test scores were average, brightness (467 lumens) seemed superior during our subjective evaluation. Data images were excellent in



The Proxima DP9200 and Proxima UltraLite DS1 boast good image quality and feature sets for the price. Both are among the best projectors in their classes.

native XGA mode, and the unit did a fine job during video playback. In interpolated 1,280-by-1,024 mode, the projector was unable to hold the signal steady—with significant interlace flickering and moiré patterns. But most units in this roundup don't even offer SXGA mode.

The Proxima UltraLite DS1, on the other hand, is an attractively priced, highly portable DLP solution. It's very good in native Super VGA resolution and acceptable for occasional use in interpolated XGA mode. Data images are very tight, and the DS1's 430-lumen output on our tests is good for a sub-10-pound projector. Like other DLP units tested in our labs, the DS1 has good Contrast Ratio scores but poor brightness uniformity.

You'll want to add external amplified speakers for high-quality audio presentations, but this product's compact size, satisfying image output, and reasonable price make it a good choice, especially if your plans include going on the road.—*BB*

Sanyo PLC-5600N

800 x 600; 700 lumens (439 tested); 13.0 lbs.; $9,995 list. Chatsworth, CA; 818-998-7332, ext. 288 or 282; www.sanyolcd.com. 548 at www.pcmag.com/infolink.

● Many other projectors in this roundup not only outperform the Sanyo PLC-5600N but are less expensive. It's heavier than most other Super VGA units here, and its high price does not include a carrying case or audio or video cables.

On our tests, the PLC-5600N did an excellent job of retaining information on compressed-resolution images—possibly better than any other projector in the group—and video images showed only slight posterization of skin tones. The green and blue panels were slightly misaligned, which was enough to put a colored halo around white objects on a black background.

At 439 lumens, brightness was adequate, but others in the PLC-5600N's class delivered more. The contrast ratio was also rather low. Motorized zoom and focus controls worked well, but the projector's lens has a longer throw than those of most of the other units, so you have to move it farther back from the screen to get the desired image size.—*AP*

Sharp Notevision3 XG-NV3XU

1,024 x 768; 600 lumens (560 tested); 14.6 lbs.; $9,495 list. Mahwah, NJ; 888-523-7427; www.sharp-usa.com. 549 at www.pcmag.com/infolink.

● The Sharp Notevision3 XG-NV3XU, from Sharp Electronics, is a good choice for a conference-room projector that will see travel duty. In our labs, it produced excellent results at its native XGA resolution and respectable scores on the Contrast Ratio, Lumens (560), and Brightness Variance tests. The manual focus and zoom controls were a bit tougher to adjust for a tight image than on other projectors. Misconvergence was noticeable in all color combinations, holding back the data-image quality rating, but video projection was consistently pleasing.

The Notevision3's volume, bass, treble, and balance controls add value, but you'll want external speakers in a larger installation. Although it's less portable than some ultralights, it has excellent video-mode performance, which makes it a good choice for fixed multimedia applications. The Notevision3 XG-NV3XB—an identical model that boosts rated brightness to 700 lumens—should be available by the time you read this.—*BB*

Sony VPL-X600U

1,024 x 768; 600 lumens (456 tested); 12.8 lbs.; $9,990 list. Park Ridge, NJ; 800-686-7669; www.sony.com/professional. 550 at www.pcmag.com/infolink.

● Although the Sony VPL-X600U is reasonably portable at 12.8 pounds, there are lighter, less expensive projectors with brighter, better-looking images. At the native XGA resolution, several of our test images with line- and dot-pattern fills showed an annoying flicker. Others had streaking and ghost images. We saw similar problems with scaled images at lower resolutions and compressed images at higher resolutions. Tested brightness (456 lumens) was adequate in a small conference room, but the screen image was among the dimmest in the unit's weight and resolution class.

Setup is straightforward, with cables and connectors labeled well enough that you probably won't need the documentation. The manual focus and zoom work smoothly and easily. But trying to control the mouse from the remote proved to be an exercise in frustration. Also, unlike other products, the VPL-X600U does not provide a technical-support number. Instead, you're directed to go through the dealer that sold you the projector. Generally, the unit is a mixed bag, and there are better deals elsewhere.—*MDS*

Its relatively dim images and problematic controls keep the Sony VPL-X600U out of the running.

Telex P600

1,024 x 768; 650 lumens (676 tested); 15.0 lbs.; $7,500 street. Minneapolis; 800-828-6107, 612-884-4051; www.telex.com. 551 at www.pcmag.com/infolink.

● A strong performer, the Telex P600, from Telex Communications, is especial-

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ly good for the user who needs an XGA projector in a conference or training room. The internal speakers provide surprisingly good audio output, and the projector includes motorized zoom and focus controls—plus complete and well-illustrated documentation to get novice users started.

The unit's test scores were above average: The tested 676-lumen output was the third-brightest in the roundup and the contrast ratio (126:1) was good. Typical data and video images looked excellent. Although there was some noticeable misconvergence and streaking on a few specialized tests, neither problem was observable in normal data- or video-image mode. At interpolated 1,280-by-1,024 resolution, the unit had some trouble controlling the image, producing lots of flicker. But the P600 remains a fine choice for XGA or lower resolutions. With its relatively high weight, it's better for fixed locations, but generally good performance makes it a safe bet for a variety of implementations.—*BB*

Toshiba TLP-511A MediaStar

1,024 x 768; 700 lumens (497 tested); 17.6 lbs.; $9,995 list. Wayne, NJ; 973-628-8000; www.toshiba.com/tacp. 552 at www.pcmag.com/infolink.

●The Toshiba TLP-511A MediaStar showed lackluster performance on our tests, with brightness and image quality that were acceptable but were outclassed by much of the competition. One feature, however, makes it recommendable: A unique imaging camera lets you project actual paper documents onto the screen. This effectively gives you both a data/video projector and a traditional overhead projector.

The MediaStar's unique camera helped us overlook its mediocre image quality.

At the native XGA resolution, we couldn't adjust the image to see the top and bottom lines of our text image at the same time. We also saw annoying streaking and ghosting on some test screens and flickering on others. Yet brightness was acceptable, and video-image quality was good.

The remote's menu controls are counterintuitive, but setup is otherwise straightforward. Manual focus and zoom work smoothly, and the document-imaging camera, which folds neatly into its own compartment, is easy to set up and use—complete with its own motorized focus and zoom.

If you'll be using the camera, you may accept the less-than-ideal performance. But note that at 17.6 pounds, the MediaStar is most appropriate for moving from room to room in an office. If Toshiba could just bring the image

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quality up to that of some other products, this would be a hands-down winner.—*MDS*

ViewSonic PJL802 ViewBook, PJ1000 Office Theater

PJL802: 800 x 600; 400 lumens (351 tested); 11.0 lbs.; $4,300 street. PJ1000: 1,024 x 768; 600 lumens (551 tested); 20.0 lbs.; $7,500 street. Walnut, CA; 800-888-8583, 909-869-7976; www.viewsonic.com. 553 at www.pcmag.com/infolink.

● A great bargain for a lightweight projector, the ViewSonic PJL802 ViewBook, from ViewSonic Corp., balances portability (it weighs 11 pounds) with adequate performance and a respectable feature set. It includes intuitive on-screen menus and easily adjustable manual focus and zoom. It also has a built-in PC Card slot, so you can run your presentation from a flash memory card and leave the PC behind.

The ViewBook posted below-average scores on our brightness and contrast tests. Its problems in these areas were apparent in subjective testing; we had to turn up the brightness control to high levels to get an acceptable image. At its native Super VGA resolution, data- and video-image quality were fine. The unit can run at interpolated 1,024-by-768 resolution, but image quality degraded considerably at this level, with visible flicker and resolution problems. Audio quality was reasonably good at moderate volume.

The ViewBook is a good choice for moderate-duty portable presentations with its smart feature set, acceptable performance, and appealing price.

On the other end of the weight spectrum is the 20-pound ViewSonic PJ1000 Office Theater, which does a great job in its native XGA resolution and is a fine choice if you're projecting video. It also has significantly better audio quality than most of the other projectors we tested.

In our labs, the Office Theater was an average performer except for a below-average contrast ratio. We had difficulty adjusting contrast to the levels that a number of other projectors easily attained, although there was no profound dullness in the image. At native XGA resolution, data and video images were excellent. But interpolated 1,280-by-1,024 performance was unacceptable, with noticeable precision, interlacing, and moire problems.

For top-quality audio and video, you can't beat the 20-pound ViewSonic PJ1000 Office Theater.

ViewSonic bundles a full complement of connection cables for A/V components with the Office Theater, along with a comprehensive manual and motorized zoom and focus. For video applications in the boardroom or classroom, there is none better, but other projectors outshine the Office Theater for straight data use.—*BB* PC

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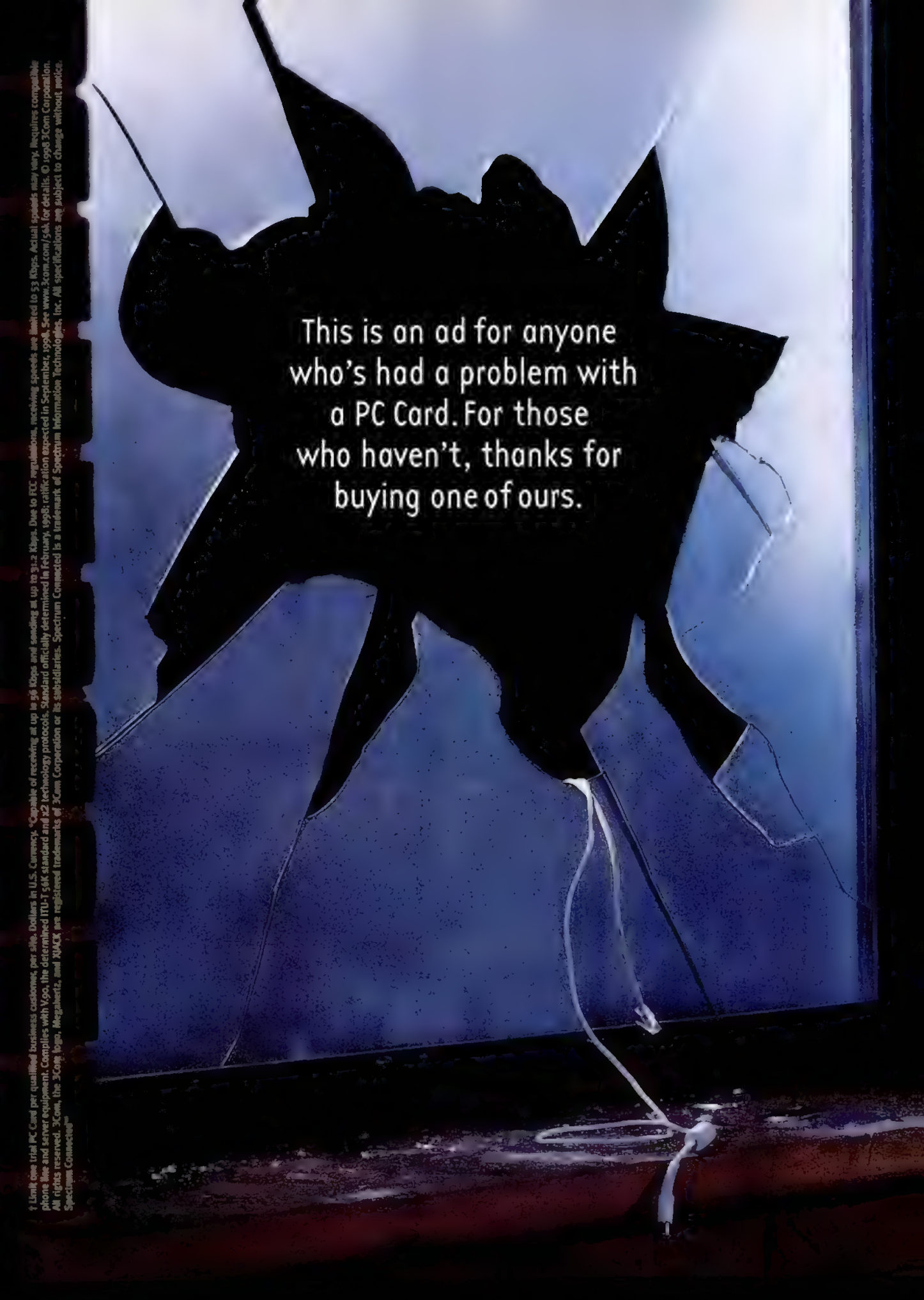

† Limit one trial PC Card per qualified business customer, per site. Dollars in U.S. Currency. *Capable of receiving at up to 56 Kbps and sending at up to 31.2 Kbps. Due to FCC regulations, receiving speeds are limited to 53 Kbps. Actual speeds may vary. Requires compatible phone line and server equipment. Complies with V.90, the determined ITU-T 56K standard and x2 technology protocols. Standard officially determined in February, 1998; ratification expected in September, 1998. See www.3com.com/56k for details. © 1998 3Com Corporation. All rights reserved. 3Com, the 3Com logo, Megahertz, and X-JACK are registered trademarks of 3Com Corporation or its subsidiaries. Spectrum Connected is a trademark of Spectrum Information Technologies, Inc. All specifications are subject to change without notice. Spectrum Connected™

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Net Tools

56K PC Card Modems

Whether you've been awaiting the first V.90 devices or simply need a 56K modem, here's how nine products measure up.

By Les Freed

These are tumultuous times for modem buyers. With the ratification of the ITU's 56K modem standard expected in September, many manufacturers have jumped the gun and begun releasing V.90-compatible products. For this feature, we tested nine 56K PC Card modems for notebook users. Seven arrived at PC Magazine Labs with either V.90 code installed, or a V.90 flash-ROM upgrade available from the company's Web site. The vendors of the remaining products expect to ship V.90 units by ratification time.

The existence of two 56K standards, K56flex and x2, has created confusion and complication for users. The V.90 standard clears this up by combining elements of both protocols. As a result, you'll be able to dial into digital corporate remote-access servers (RAS) and ISP access nodes with any V.90 modem, just as you could previously with 33.6-Kbps models.

Though the pieces are in place for a smooth transition to V.90, we strongly advise against upgrading prematurely. Despite the availability of V.90 firmware, you could still experience compat-

PHOTOGRAPHY BY THOM O'CONNOR

INSIDE

IS V.90 HERE FOR REAL? Though the V.90 modem standard isn't ratified, plenty of vendors are already offering V.90 models. Contributing editor Les Freed and PC Magazine Labs put nine 56K PC Card modems through their paces.

NEVER A DOWN MOMENT Using clustered servers is a great way to keep your mission-critical applications up and running, but it has always required you to invest in two identical servers running pricey clustering software. Contributing editor Steve Rigney checks out Vinca's Co-StandbyServer, a low-priced clustering solution that lets you use servers with different configurations. *Page 301.*

ARE YOU SECURE? Contributing editor Padraic Boyle tests solutions from Intrusion Detection and Internet Security Systems that let you know if someone's been snooping on the LAN. *Page 301.*

REMOTE BACKUP Online backup solutions aren't one-size-fits-all. Steve Rigney puts Connected's Connected Online Backup and CoreData's RemoteWorx to the test. *Page 306.*

VIRTUAL NETWORKS Contributor Bill Ulrich examines Mobiliti's Network/Unplugged, a handy application that caches your network files locally. *Page 312.*

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Net Tools

56K PC CARDS

ibility problems. Until the dust settles and ISP and RAS access servers are upgraded to V.90, the safest approach will be to stick with your proprietary 56K or V.34 device.

Though vendors readily sent us V.90-capable products, our performance testing yielded some unwelcome surprises. All but two of the V.90-capable products failed to complete our V.90 tests: They couldn't negotiate and maintain connections on lines with impairments. The two that did work—the Diamond Supra PC Card 56K and the 3Com Megahertz 56K Global Modem PC Card (our Editors' Choice)—were fast but varied widely in connect speeds.

Performance results using 56K and V.34 modes fell within an acceptable range, but the numbers were by no means predictable. For instance, the two fastest performers at V.90 and K56flex—3Com's Global Modem and the Viking 56K PC Card Modem, respectively—were slow in V.34 mode. The fastest in V.34 mode, the Ositech Five of Hearts Trumpcard, was the slowest at K56flex. V.34 speeds are particularly important to users who often connect from places where 56K digital connections aren't possible, such as behind a PBX or hotel switchboard (see the sidebar "No Room Service After 33.6 Kbps").

WHAT A TIME TO BUY A MODEM

If you still plan to move to V.90 right away, by either buying a new modem or upgrading your existing 56K device, do some homework first. Find out what your ISP's or company's upgrade plans are and whether the forthcoming back end will be backward-compatible with your K56flex or x2 modem. But more important, make sure the modem contains at least 2MB of flash ROM—enough to hold both the proprietary 56K and the V.90 code. This way, you'll be able to connect to back ends that support both.

If you upgrade to V.90 a modem that contains only 1MB of flash ROM, the unit will still operate but potentially at lower speeds. When you upgrade, the new firmware will overwrite your proprietary 56K code, leaving you only V.90 and V.34 as possible connections. (All 56K and V.90 modems contain V.34 code.) So if the back end you dial into hasn't been upgraded to V.90, your connection will revert to V.34 mode. You'll need to reflash your modem to revert to your proprietary 56K capability, but by doing so, you'll lose the V.90 mode. Of the products we tested, all but the Compaq Netelligent 56K PC Card Modem and Diamond Supra supplied enough memory to contain both sets of firmware.

Many of the products we tested also include wizards to ease the upgrade process. These programs automatically detect your modem, determine the current firmware, and ask whether you wish to upgrade. The wizards from Diamond, Hayes, and Zoom particularly impressed us.

WORKING AROUND V.90

If you need a 56K modem and can't afford to wait for the V.90 compatibility and performance issues to shake out, you'll want to consider design, feature set, and price. In this roundup you'll find several good packages, with street prices ranging from $115 to $270—only slightly higher than you'd pay for a V.34 model.

Several products tout unique design features. The Xircom CreditCard Modem 56K includes status LEDs to demonstrate when it's connected and sending or receiving data. Most units we tested provide a generic 6-foot RJ-11 phone cable with an unlabeled PC Card connector at one end and a male phone plug at the other. But two modems—Xircom's CreditCard and the Hayes Optima—use a superior adapter equipped with a female phone connector to which you can attach any length of phone cord.

Many packages include extras to suit a variety of business needs. Six modems will integrate with optional connection kits that let you dial out using your cellular phone. Five packages include support for the V.80 protocol, which means you can do videoconferencing on the road. Moreover, Hayes' Optima and Zoom's Dualmode each include voice mail software that transforms your notebook into an answering machine.

Although V.90 is a worldwide standard, the electrical signals used on phone lines vary among countries. International travelers should select from three packages that make it easier (or possible) to connect with foreign lands. The CreditCard and the Global Modem offer adapter kits and utilities for configuring the modem for nonstandard phones. But Ositech takes a unique approach, using its Digital Phone Interface (DPI) technology to connect the Five of

SUMMARY OF FEATURES See www.pcmag.com for interactive views

56K PC Card Modems

■ YES ▣ NO	Compaq Netelligent 56K PC Card Modem	Diamond Supra PC Card 56K	Hayes Optima 56K PC Card	MultiTech MultiMobile Modem Series	Ositech Five of Hearts Trumpcard	3Com Megahertz 56K Global Modem PC Card	Viking 56K PC Card Modem	Xircom Credit Card Modem 56K	Zoom Dualmode PC Card 56K FaxModem
List/street price	N/A / $200	$169.95 / N/A	$269.00 / $210	$299.00 / $200	$259.00 / $230	$269.00 / N/A	$125.00 / $120	$259.00 / $220	$199.00 / $150
Chip set	Rockwell	Rockwell	Lucent	Lucent	Rockwell	Texas Instruments	Rockwell	Lucent	Rockwell
ROM	1MB	1MB	2MB	4MB	2MB	4MB	2MB	4MB	2MB
Features									
Supports K56flex / x2 / V.90	■	■	■	■	■	■	■	■	■
Power-conservation mode	■	■	■	■	■	■	■	■	■
RJ-11 cable type	Male	Male	EZ Jack	Female	Male	Male	Male	Female	Male
Cellular-capable	▣	▣	■	■	■	▣	■	■	■
Distinctive ring	■	■	▣	■	■	▣	■	■	■
V.80 videoconferencing support	■	■	■	▣	■	▣	▣	▣	■
Service and Support									
Warranty	5 years	5 years	5 years	5 years	5 years	Lifetime	5 years	Lifetime	2 years
Toll-free technical support	■	▣	■	■	■	■	■	■	▣

N/A—Not applicable. The vendor does not cite this price.

Hearts to a telephone handset rather than into the phone line. This lets you use the modem with virtually any phone—analog or digital—anywhere.

The bottom line: If you must buy a 56K modem today, hedge your bets by buying a modem that contains enough flash ROM to fit 56K proprietary code and V.90 firmware.

Compaq Netelligent 56K PC Card Modem

Sold as an accessory to Compaq's laptop computers, the Compaq Netelligent 56K PC Card Modem ($200 street) is well suited to the business user. Though it doesn't include international capabilities or cellular connectivity, it provides V.80 videoconferencing support, as well as the loudest audio of the units we tested. There's an above-average manual, and K56flex performance was acceptable on both 56K and V.34 connections in our testing. Like Xircom, Compaq did not provide V.90 firmware for our tests.

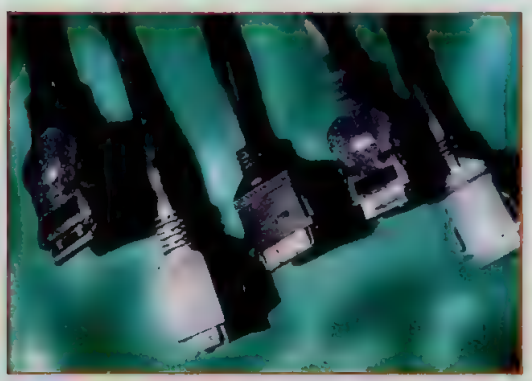
Installation was quick and easy. The generic manual covers several other Compaq models, so you'll need to dig around to find your unit. Nevertheless, the manual was one of only a few that included a useful AT command and S-register reference section—a must-have for users who need to customize communications settings for international dialing or specialized corporate dialing routines.

The Netelligent's connectors are standard fare: a 6-foot phone cable with a small, unmarked PC Card connector. On the plus side, the modem produced the loudest audio in the roundup, making it easy to hear dialing and call-progress tones on even the tiniest laptop speaker. Moreover, V.80 protocol support makes this product one of only a handful of modem choices for H.324 (POTS) videoconferencing while on the road. Note that the only software included with our unit was Delrina's WinFax Lite.

Although the Netelligent was not V.90-capable when we tested, it posted average performance scores under K56flex. Its only standout results were in the Digital Impairment tests, on which it recorded above-average throughput. Compaq will provide a free wizards-based V.90 flash upgrade when the standard is ratified.

If you're getting a Compaq laptop or need videoconferencing on your portable, the Compaq Netelligent won't disappoint you.

Compaq Netelligent 56K PC Card Modem. Street price: $200. Compaq Computer Corp., Houston; 800-345-1518; www.compaq.com.



WHICH END IS UP? *The telephone cables included with the Netelligent and others don't mark the top of the PC Card connector clearly.*

Diamond Supra PC Card 56K

Distinguishing itself as the only unit besides the Global Modem to operate using V.90 firmware, the consumer-oriented Diamond Supra PC Card 56K ($169.95 list) appeals with lively performance, an extensive software bundle, and V.80 videoconferencing support—at a competitive price.

Installation was rote. Like many of the less expensive models, the Supra includes a cable with an unlabeled PC Card connector. Diamond provides documentation only on the CD-ROM and in HTML format. Users who lack portable CD-ROM drives must copy the files onto a floppy disk, then save them to the hard disk.

The Supra produced high numbers on the Throughput and Digital Impairment tests, but it also exhibited a wide variation in speeds during our Impairment tests—probably due to the early V.90 firmware. Speeds at V.34 were impressive. A note of caution, though: The device we tested contained only 1MB of flash ROM. If you need to connect using K56flex mode, you'll have to use Diamond's wizards to reflash the modem.

If your laptop has a CD-ROM drive, you'll appreciate Diamond's software bundle. Although much of the package (Adobe Acrobat Reader, BackWeb, Internet Explorer 4.0, and Netscape Navigator 4.0) is available for free, having all the programs on one disk is convenient. Moreover, Diamond uses the BackWeb client to distribute product news and firmware updates auto-

EDITORS' CHOICE

• 3Com Megahertz 56K Global Modem PC Card

We thought the V.90 specification was finally here when vendors began sending us V.90-capable modems for this story. But when we got the early firmware into our labs, we found it still had quite a way to go. To complicate matters further, the V.90 firmware versions we tested have all since been updated numerous times, so our performance results are a snapshot of code under development rather than a definitive indicator of the modems' performance.

Though most of these modems had problems attributable to early V.90 code, the striking exception was the 3Com Megahertz 56K Global Modem PC Card. It not only operated using V.90 firmware but demonstrated peerless performance on our tests.

The Global Modem ($269 list) provides plenty of features for the world traveler, such as a country-selector program, troubleshooting utilities, and 24-hour worldwide technical support. For connecting in unfamiliar places, the Global Modem also includes a UK-style adapter plug, which is the second-most-common connector after the RJ-11. Excellent documentation and a toll-free test call made the installation the smoothest we experienced.

Three of the products warrant honorable mention. The Xircom CreditCard Modem 56K ($220 street) is unmatched in design and provides a fine set of features for the world traveler. The Ositech Five of Hearts Trumpcard ($230 street) touts a unique handset configuration that lets you connect to almost any phone without bulky adapters. And at $120 (street), the Viking 56K PC Card Modem presents a compelling value with cellular connectivity, Macintosh support, and fast, stable performance.

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Diamond Supra PC Card 56K. List price: $169.95. Diamond Multimedia Systems Inc., San Jose, CA; 800-727-8772, 408-325-7000; www.diamondmm.com. *Choose 908 at www.pcmag.com/infolink.*

Hayes Optima 56K PC Card

A longtime player in the modem market, Hayes Corp. has built a reputation for quality products. With minor exceptions, the Hayes Optima 56K PC Card ($210 street) is a capable performer; it's full of useful features and has a notable software bundle. The trouble is that its high price tag bumps it into a class of superior products where it competes poorly.

An uneventful installation had us up and running in minutes. But the documentation is too sparse, even for a plug-and-play device.

We have mixed feelings about the design. It's the only product here to use an EZjack connector, a retractable RJ-11 female jack that pops out from the side of the card. Compact and fairly rugged, the connector lets you attach a phone cord of any length. But on some laptops, the connector forces the phone cable to stand perpendicular to the keyboard, so that it constantly gets in the way. The Optima also offers an optional cellular-connection kit.

In the standard array of software, you'll find BVRP Software's PhoneTools Graphic. PhoneTools' voice mail can be especially useful to the business traveler who's staying in a hotel without voice mail or who's hampered by a cumbersome message system. But note that the only other product here to offer voice mail, Zoom's Dualmode, also supports V.80 videoconferencing—and for $60 less.

IN THE WAY: *On certain laptops, the Hayes' Xjack connector puts the telephone cord in your way when you're trying to type.*

The Optima's V.90 upgrade could not complete our testing, and its 56K performance generally placed it in the middle of the pack. The flash ROM contains dual-mode K56flex/V.90 firmware, and Hayes plans to make a free wizards-based V.90 flash upgrade available by the time you read this.

If having a modem with the famous Hayes name is important to you, you won't go wrong with the Optima; but you will pay too much.

Hayes Optima 56K PC Card. Street price: $210. Hayes Corp., Norcross, GA; 770-840-9200; www.hayes.com. *Choose 909 at www.pcmag.com/infolink.*

MultiTech MultiMobile Modem Series

Though it doesn't dominate in any one area, the MultiTech MultiMobile Modem Series ($200 street) is a well-rounded, above-average product. Its detailed manual, excellent design, and cellular capability present a good value that domestic business travelers will especially appreciate.

Installation was typical plug-and-play. We were impressed by the printed manual, which includes a detailed AT command and S-register summary, troubleshooting help, and—

FASTCONNECTION

No Room Service After 33.6 Kbps

Inherent in 56K PC Card modems lies a contradiction: Mobile users are typically the earliest adopters of emerging technologies such as 56K, but at the same time, they're the group least likely to encounter 56K-capable phone lines.

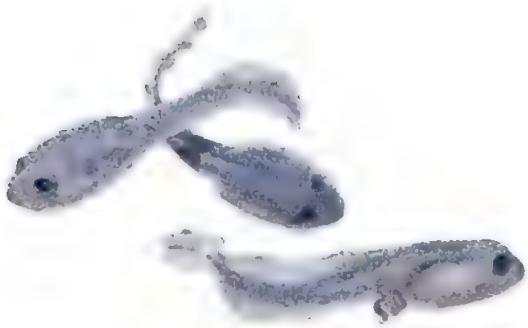
About 25 percent of the lines in North America are connected to the phone company by using a device called a subscriber line concentrator (SLC). SLCs connect to the central office via a digital signal and will work with 56K modems, since there is only one conversion in the line. But some older central office equipment can't connect to a digital SLC, so the signals are converted back to analog and then reconverted to digital inside the central office. Multiple conversions introduce a small amount of noise and distortion into the signal, which prevents modems from operating at high speeds.

Most hotel and small-office PBX systems suffer from the same (or a similar) problem. They often convert the extension lines to digital inside the PBX, then reconvert them to analog for connection to the outside world. That adds two analog-to-digital conversions to the signal before it ever leaves the building.

3Com has set up a test system that you can call from any phone line to see whether the line is 56K-capable. Go to 3Com's Web site at *www.3com.com/56k/need4_56k/linetest.html* for more details.—*LF*

The Path of a Successful 56K Connection

To achieve a 56K connection, the signal can sustain no more than one analog-to-digital conversion. This situation is most likely with an analog signal that travels over copper wire to the phone company's central switch. There, the switch converts the analog signal to digital, then sends it over the backbone network to an ISP.



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CISCO SYSTEMS

EMPOWERING THE

unique to MultiTech—a chart of commonly used IRQ settings. The settings are of great help for resolving device conflicts on your laptop. The MultiMobile's software bundle consists mostly of trial versions and games, ill suited to the corporate market.

The product's design is a cut above those of many competitors. The cable's connector end is clearly labeled, the line cord is sturdier than most, and the RJ-11 plug includes a strain-relief device, which helps prevent accidental cable damage. The package also offers an optional cellular-connection kit.

SIMPLE AND STRONG: *MultiTech clearly marks the PC Card connector, and a strain-relief device prevents damage to the rugged telephone jack.*

The MultiMobile turned in respectable performance scores. Though it failed to work after we ran the wizards-based V.90 flash upgrade, the unit performed well in K56flex mode. It finished toward the bottom of the pack on our Digital Impairment tests but came in among the top third on our Throughput tests.

If you're a business traveler looking for a modem with an above-average design at a good price, put the MultiMobile on your short list.

MultiTech MultiMobile Modem Series. Street price: $200. MultiTech Systems Inc., Mounds View, MN; 800-328-9717, 612-785-3500; www.multitech.com. *Choose 910 at www.pcmag.com/infolink.*

Ositech Five of Hearts Trumpcard

If you're a globe-trotter who likes to pack light, the Ositech Five of Hearts Trumpcard ($230 street) is your modem. Though products such as 3Com's Global Modem and Xircom's Credit Card require you to buy adapter kits for the countries you visit, the Five of Hearts uses a cable adapter that links to almost any phone's handset port. Moreover, the modem had top throughput scores on our tests at V.34, the mode you'll be likely to use most in unfamiliar settings.

The Five of Hearts' installation was uneventful in our labs, and documentation is adequate. The modem is the only one with international capabilities that supports the V.80 videoconferencing protocol, and it is also the only unit with Windows CE drivers.

The unique design includes two cords: an RJ-11 cable and a short RJ-9 cable that attaches to any modular handset port. The Five of Hearts uses the RJ-9 cable and companion software to connect to foreign phones or to digital PBX systems that don't use RJ-11 cables. One utility configures the modem to work with a variety of telephone sets, and another helps to complete the call.

Using the handset configuration, we placed calls with a variety of handset jacks. The connection speeds weren't fast—the best we saw was 16.8 Kbps—but flexibility and convenience offset the slow speeds.

When we tested the Five of Hearts using a standard RJ-11 connection, it had variable results on our Throughput tests and had stable but slower speeds on the Digital Impairment tests. Though the V.90 code could not pass our Impairment tests, Ositech promises a free flash ROM upgrade by the time you read this.

Overseas travelers who demand top-tier performance should consider 3Com and Xircom. But if you use a Windows CE device or value convenient, ubiquitous connections, the Five of Hearts will be perfect for you.

A SINGLE SOLUTION: *The Five of Hearts comes with a unique handset jack connector that lets you plug it into nearly any phone.*

Ositech Five of HeartsTrumpcard. Street price: $230. Ositech Communications Inc., Guelph, Ontario, Canada; 1-800-674-8324; www.ositech.com. *Choose 911 at www.pcmag.com/infolink.*

3Com Megahertz 56K Global Modem PC Card

PC MAGAZINE EDITORS' CHOICE

For a modem that's packed and ready to see the world, consider the 3Com Megahertz 56K Global Modem PC Card ($269 list). Certified for use in 24 countries, it provides plenty of perks to attract the globe-trotter. It arrived at our labs with V.90 code installed, and its performance was peerless. Add in the best manual we saw, a lifetime warranty with international support, and excellent utilities and you have a modem in a class by itself. It wins our Editors' Choice.

In a field marked by rote installations, the Global Modem stands out. The install program automatically dialed a toll-free test server, providing instant reassurance that our modem worked. And the manual was the best of the bunch, including detailed diagnostic information and modem travel tips.

The package includes a raft of notable features, such as a helpful diagnostic utility for troubleshooting from anywhere and a useful country-selector utility for setting international line-interface characteristics. There's also a UK-style telephone adapter plug, the second-most-common plug after the RJ-11 jack. But if cellular connectivity is a must-have for you, look to Ositech or Xircom instead.

The Global Modem uses a conventional snap-on cable rather than the Xjack connector, previously offered in the Megahertz line (and used in the Optima). The new cable is much better, but the PC Card connector is not clearly marked. Like Xircom, 3Com includes a hard plastic carrying case to protect the modem in your computer bag.

The Global Modem dominated our Throughput and Digital Impairment tests. Its Impairment results were highly variable, though, an effect likely caused by the early firmware. Performance at V.34 was slow, but that probably resulted from connecting to the K56flex back

56K PC Card Modems

PC MAGAZINE LABS

Seven of the nine vendors made early V.90 code available for our roundup—either as primary code or in a Flash-ROM upgrade. But only two modems—the 3Com Megahertz 56K Global Modem PC Card and the Diamond Supra PC Card 56K—were able to complete our tests using V.90 connections. The remaining five units maintained V.90 connections only under optimal line conditions. When we introduced digital impairments to the lines, they failed to negotiate and maintain connections.

Because V.34 performance continues to be an important part of the connection picture, we tested modem throughput under both V.34 and 56K connections. For the **Throughput** test, we transferred data across a simulated line containing almost no impairments. We tested the units at V.34 and at either V.90 or the proprietary 56K (whichever worked), and our tests prove that 56K modems can improve performance as much as 80 percent over V.34 speeds. The V.34 speeds ranged from 24.8 Kbps for the Global Modem to 28.8 Kbps for the Supra; the 56K connections ranged from 36.7 Kbps for the Five of Hearts to 44.9 Kbps for the Global Modem. Although the Global Modem (our Editors' Choice) turned in the slowest V.34 scores, this is probably the result of incompatibilities between the modem's Texas Instruments chip set and Rockwell-based RASs, which caused the device to revert to 28.8 mode.

For best simulation of real-world connections, our **Digital Impairments** tests subjected the modems to 18 digital line conditions while transmitting data. The chart shows the average speed of the 18 different connections, as well as minimum and maximum connection speeds to illustrate variability. Ideally, products should have produced high throughput with a low variation in speed. As you can see, the Viking 56K did well on both fronts. The two working V.90 products (the Supra and the Global Modem) delivered higher throughputs but also displayed a wide range of speeds.—*Analysis written by Kevin Young*

How We Tested

To simulate real-world line conditions that modems encounter when connecting to a phone company's central site, we used a Telecom Analysis System (TAS) 240 local-loop emulator and a TAS Series II central-site simulator. We then connected the TAS Series II to a remote access server (RAS) through a channelized T1 line. We used two RAS units—an Ascend MAX 4048 for the K56flex devices and a 3Com Total Control Remote Access Concentrator for the V.90 units. At test time, 3Com was the only vendor to provide us with V.90 code for its RAS. All the units we tested that didn't work under V.90 used K56flex technology.

THROUGHPUT TESTS FOR 56K AND V.34*

High scores are best.
Bold type denotes first place.
denotes Editors' Choice

	Possible 56K connections	Successful 56K connections	Connection type used for testing	56K Kbps	V.34 Kbps
Compaq Netelligent 56K PC Card Modem	K56flex	K56flex	K56flex	38.34	27.72
Diamond Supra PC Card 56K	V.90, K56flex	V.90	V.90	41.31	28.08
Hayes Optima 56K PC Card	V.90, K56flex	K56flex	K56flex	41.94	26.91
MultiTech MultiMobile Modem Series	V.90, K56flex	K56flex	K56flex	42.48	25.29
Ositech Five of Hearts Trumpcard	V.90, K56flex	K56flex	K56flex	36.72	28.80
PC 3Com Megahertz 56K Global Modem PC Card	V.90, x2	V.90	V.90	44.91	24.84
Viking 56K PC Card Modem	V.90, K56flex	K56flex	K56flex	43.92	26.74
Xircom CreditCard Modem 56K	K56flex	K56flex	K56flex	40.77	27.72
Zoom Dualmode PC Card 56K FaxModem	V.90, K56flex	K56flex	K56flex	36.81	25.74

* We tested the modems using a noncompressible file.

◀ Because mobile users often need to dial through lines in hotel and conference rooms that frequently don't support 56K connections—V.90 or proprietary—it's arguable that achieving reliable V.34 connections is as important or more so than attaining 56K speeds.

▼ Because these tests transfer a moderately compressed file, they also highlight the modems' compression capabilities. Compression lets all the modems average at least 65 Kbps, with the Global Modem achieving speeds above 100 Kbps.

DIGITAL IMPAIRMENT TESTS FOR 56K*

High scores are best.
Bold type denotes first place.
denotes Editors' Choice

	Possible 56K connections	Successful 56K connections	Connection type used for testing	Average Kbps	Maximum Kbps	Minimum Kbps
Compaq Netelligent 56K PC Card Modem	K56flex	K56flex	K56flex	70.80	87.39	51.57
Diamond Supra PC Card 56K	V.90, K56flex	V.90	V.90	68.48	99.81	15.03
Hayes Optima 56K PC Card	V.90, K56flex	K56flex	K56flex	65.71	87.75	35.55
MultiTech MultiMobile Modem Series	V.90, K56flex	K56flex	K56flex	65.43	87.48	49.68
Ositech Five of Hearts Trumpcard	V.90, K56flex	K56flex	K56flex	73.63	88.66	60.67
PC 3Com Megahertz 56K Global Modem PC Card	V.90, x2	V.90	V.90	83.50	104.04	45.18
Viking 56K PC Card Modem	V.90, K56flex	K56flex	K56flex	73.20	98.20	61.11
Xircom CreditCard Modem 56K	K56flex	K56flex	K56flex	66.69	87.03	46.62
Zoom Dualmode PC Card 56K FaxModem	V.90, K56flex	K56flex	K56flex	65.04	87.84	50.76

* We tested the modems using a compressible file.

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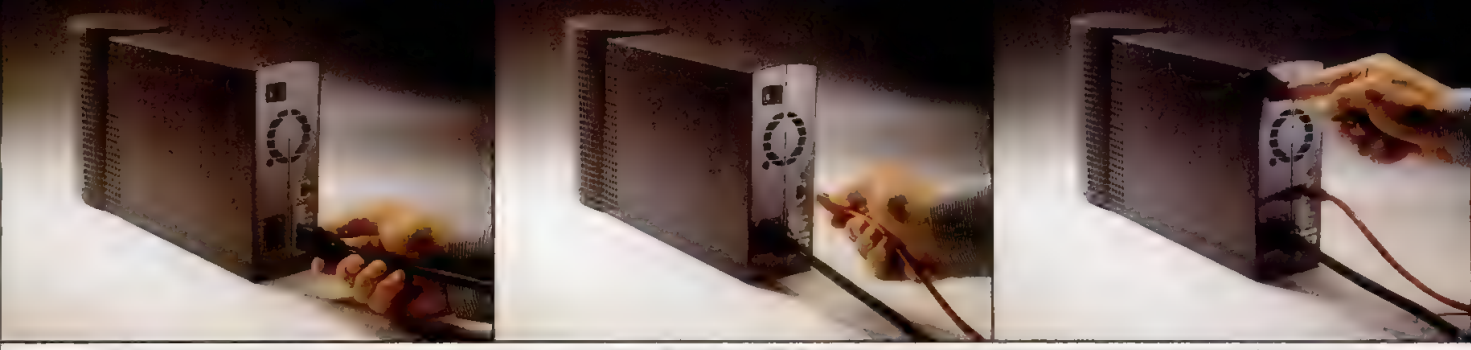

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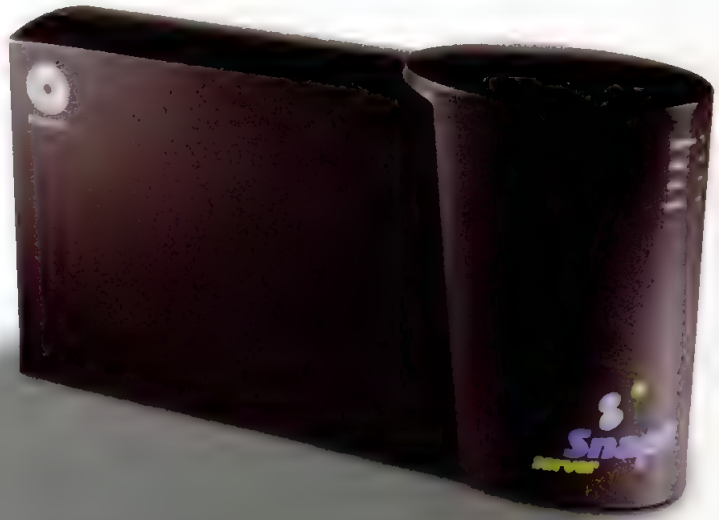

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With its strong performance and wealth of features, the Global Modem is an outstanding choice for any traveler.

3Com Megahertz 56K Global Modem PC Card. List price: $269. 3Com Corp., Santa Clara, CA; 800-638-3266; www.3com.com/mobile. *Choose 912 at www.pcmag.com/infolink.*

Viking 56K PC Card Modem

Targeted at the low-end consumer market, the Viking 56K PC Card Modem ($120 street) is the bargain offering of the bunch. Although its price gets you few bells and whistles, you will come away with cellular phone connectivity, cross-platform support, and fast, reliable 56K performance.

The Viking 56K's packaging and design are a no-frills affair. The unit comes with a standard, unlabeled telephone cable, and the documentation consists of a single-sheet installation guide that was barely enough to get us up and running. Software consists of Smith Micro's QuickLink Mobile and an AOL disk.

CONSTANT FEEDBACK: *The Xircom Credit Card Modem 56K has two clever LEDs that display your connection and transmission status.*

In addition to providing cellular phone support, the Viking 56K is the only product here to help with the tricky process of ordering the correct cellular cable for your phone. You just call the toll-free service number, provide your cellular phone model information, and the vendor sends you the correct cable. In addition, the Viking 56K is the only modem in the roundup to bundle drivers for Mac OS. And the five-year warranty with 24-hour, toll-free technical support is more generous than even some high-end products' warranties.

Performance was both fast and stable at 56K. Though it failed to complete our tests using V.90 firmware, the Viking 56K turned in the second-fastest throughput scores and displayed the least variation on our Impairment tests. The device packs enough flash ROM for dual-mode operation, and Viking offers free flash upgrades to subsequent V.90 updates. On V.34 connections, however, the modem was relatively slow. Bargain hunters who require fast and reliable 56K performance: This one's for you.

Viking 56K PC Card Modem. Street price: $120. Viking Components Inc., Rancho Santa Margarita, CA; 800-338-2361, 714-643-7255; www.vikingcomponents.com. *Choose 913 at www.pcmag.com/infolink.*

Xircom CreditCard Modem 56K

Rounding out our trio of vendors catering to the world traveler is Xircom. Like the Ositech and 3Com products, the Xircom CreditCard Modem 56K ($220 street) brings to the table a host of features for the international traveler. But what makes the CreditCard stand out is its innovative design.

Installation is a breeze. The package includes an extensive user's manual containing configuration and troubleshooting information as well as a complete AT command and S-register reference. You'll also find phone numbers for Xircom's U.S. and international support offices.

As was the case with Compaq, Xircom did not provide early V.90 code for testing. The modem contains 4MB of flash ROM, which provides plenty of room for the forthcoming free V.90 flash update to operate in either V.90 or K56flex modes. On our 56K tests, Xircom delivered good, even-handed scores across the board.

Where other vendors have made design strides in connectors or cables, Xircom goes a step further. You'll find two LEDs located on the PC Card connector to indicate modem connection status, which provide reassurance that you haven't lost the connection.

What's more, the CreditCard is the only package of the three to provide a cord with a female RJ-11 connector instead of a male plug. Such a design adds flexibility for connecting long cables or international phone cords. There's also a hard plastic carrying case for the PC Card (found elsewhere only with the 3Com) and an optional cellular connection kit. The CreditCard has a country selector utility similar to 3Com's and offers an optional international connector kit for use in 160 countries.

Globe trotters and homebodies alike are sure to appreciate the CreditCard's charms.

Xircom CreditCard Modem 56K. Price: $220 street. Xircom Inc., Thousand Oaks, CA; 800-438-4526, 805-376-9300 www.xircom.com. *Choose 914 at www.pcmag.com/infolink.*

Zoom Dualmode PC Card 56K FaxModem

Zoom's mid-priced entry in the business marketplace is a mixed bag. We found the Zoom Dualmode PC Card 56K FaxModem ($150 street) confusing to set up and a relatively slow performer. But as the name indicates, the unit provides both K56flex and V.90 operation as well as an excellent combination of voice mail, cellular connectivity, and V.80 videoconferencing functions sure to attract many users.

An otherwise simple installation was marred by a search for drivers. After routing around, we found them on the WinFax Lite disk, with no indication of their location on the WinFax disk. The documentation provides troubleshooting tips and an AT command reference but lacks an S-register summary. In addition, we found a manual in Adobe Acrobat format on the CD-ROM suited only to users of Zoom's desktop modems.

True to the name, the DualMode packs enough ROM to hold both V.90 and K56flex modes, though its V.90 code failed to work on our tests. Though dual-mode flexibility is important, we consider it more as an essential component than as an added feature—at least until V.90's adoption is complete. The unit delivered acceptable performance, but it finished near the bottom on our tests.

If you can look beyond performance, you may find the package's telephony features and V.80 videoconferencing support enticing. Zoom's roots are in telephone accessories, so it's no surprise that the modem includes a wave device driver that lets it operate as a voice mail system. The Dualmode provides a cellular connectivity kit and information for easing the cellular-cable ordering process.

Though it doesn't shine in all respects, if you're looking for videoconferencing and voice mail capabilities at a low price, the DualMode delivers.

Zoom Dualmode PC Card 56K FaxModem. Price: $150 street. Zoom Telephonics Inc., Boston; 617-423-1072; 800-631-3116; www.zoomtel.com. *Choose 915 at www.pcmag.com/infolink.* PC

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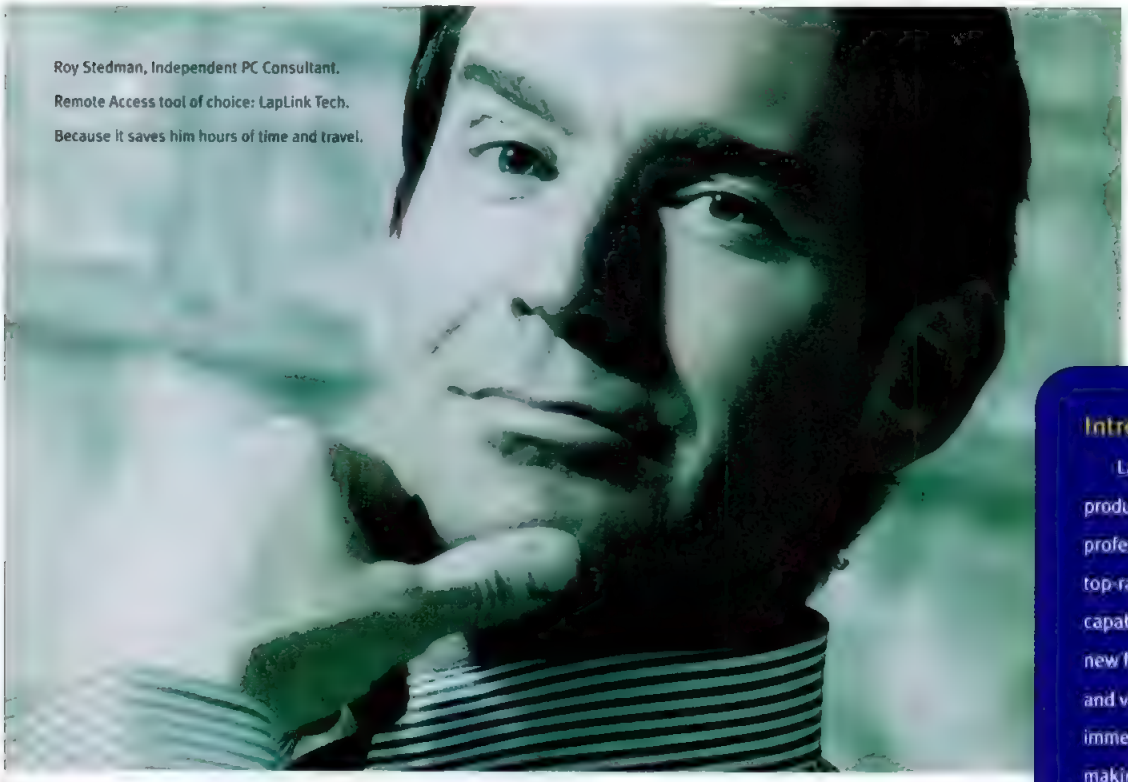

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Net Tools

FROM THE BENCH

HIGH-AVAILABILITY SERVERS

Clustering for the Masses

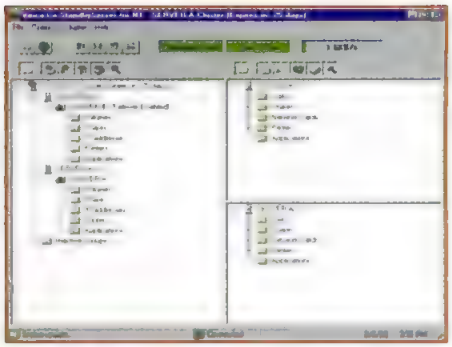
By Steve Rigney

Guaranteeing constant uptime for your mission-critical servers no longer has to be a budget-busting proposition. Vinca Corp. offers a low-cost, versatile clustering solution with its Co-StandbyServer for Windows NT ($4,499 list). Clustering lets one server take over the duties of a second server when it fails.

The product goes beyond existing solutions on both ends of the cost spectrum, such as NetWare 4.1 SFT III and Microsoft Cluster Server (MSCS). Co-StandbyServer doesn't require the clustered servers to share the same configuration, to have one of the servers inactive until a failover, or to be placed closer together than the distance that Fast Ethernet requires.

Co-StandbyServer does make one configuration demand, though: Each clustered PC must contain three hard disks, a 100-Mbps Ethernet network adapter, and a secondary network adapter. We tested the product using a Gateway NS 7000 (with a 233-MHz Pentium processor, 128MB of RAM, and a 12GB hard disk) and a Compaq ProLiant 1500 (with dual 133-MHz Pentium processors, 128MB of RAM, and a 16GB hard disk).

In most comparable solutions, the paired servers appear as separate systems to network users. But Co-StandbyServer uses aliases to treat them as a single entity. During testing, we logged on to the primary server and mapped three drives and a printer port. When we downed that server, Co-StandbyServer automatically switched us to the second server, retaining our mapped connections. The servers switched over in less than 30 seconds. Results depend on your hardware configuration, but you can expect similar performance.



SHARE AND SHARE ALIKE: *Co-StandbyServer lets a pair of servers share IP addresses and printer connections as well as files.*

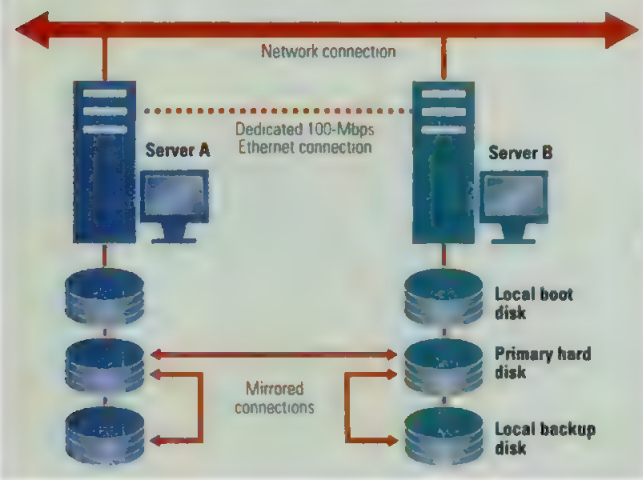
Another benefit is that Co-StandbyServer doesn't require you to reboot the system or log on to the new server after the switchover. But unlike MSCS, Co-StandbyServer doesn't mirror the server's registry. So if you're running an application that makes dynamic registry changes, you'll need to reboot.

Vinca is at work creating failover scripts for individual applications that will let them remain running during the switchover. Currently, the company offers failover scripts for Microsoft SQL and Exchange Server, which are free from its Web site.

Co-StandbyServer for Windows NT. List price: $4,499. Requires: Two PCs, each with three hard disks, a 100-Mbps Ethernet adapter, a second Ethernet adapter; Microsoft Windows NT 4.0. Vinca Corp., Orem, UT; 800-934-9530, 801-223-3100; fax, 801-223-3107; www.vinca.com. *Choose 900 at www.pcmag.com/infolink.*

Economical Clustering

Unlike higher-end server-clustering solutions, Vinca's Co-StandbyServer doesn't use a shared SCSI hard disk subsystem. Instead it mirrors each server's primary hard disk via a dedicated 100-Mbps Ethernet connection, which also carries the continuous heartbeat ping between the servers. A local backup disk also mirrors the local primary hard disk and provides an additional level of fault tolerance



NETWORK SECURITY

Who's Been Sleeping in My Bed?

By Padraic Boyle

Firewalls are a big piece of the network security puzzle, but they shouldn't be the only one. Every time you configure your firewall to let a new Internet service through, you also open the door for possible hackers. For a second line of defense, consider intrusion-detection applications that monitor and report suspicious user behavior on your network. These solutions warn you not only of external threats, but internal ones as well.

In this roundup, we test solutions for your Windows NT network from two industry grandfathers: Internet Security Systems and Intrusion Detection. Their products use different intrusion-detection methods, with RealSecure 2.0 adding bite to its bark by providing the ability to terminate the offender's connection.

Intrusion Detection

Kane Security Monitor

Need to know if someone's been raiding your Windows NT network? Intrusion Detection's Kane Security Monitor (starting at $1,500 list per server) is a flexible and easy-to-implement solution with strong reporting capabilities. KSM detects network breaches by monitoring your primary and backup domain controllers. When an intrusion occurs, KSM sends out an alert and logs a report. KSM won't terminate the harmful connection, though, so if you need to stop intruders dead in their tracks, look at RealSecure 2.0.

Installation is a breeze, thanks to KSM's excellent wizards. We were able to set up our server agent and console and distribute the client agents from a single seat. We found the console inter-

CROSS TALK

Frank, I can understand the beauty of KSM's centralized reports. That product takes a huge pile of data and makes it into useful information. I love it. But RealSecure seems like overkill. I know that even paranoids have enemies, but do you think RealSecure is worth its hefty price tag?

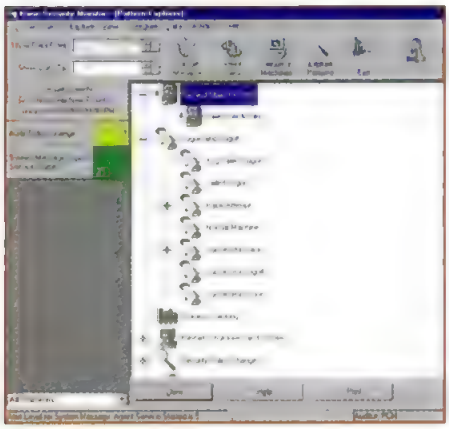
I'd love to have RealSecure protecting my online business applications, Leon. When you measure downtime in terms of many lost dollars per second, the peace of mind alone is worth the price. RealSecure, with its robust set of features, is the topping for a sound administrative security system.

face easy to navigate, making simple work of configuring alerts, audits, and security policies.

Without KSM's help, you might pick through all your Windows NT security logs by hand looking for suspicious activity. But KSM saves you time and effort by consolidating the logs and then comparing the relevant entries against a database of known patterns of attack, called *fingerprints*. On detecting a match, the program sends out an alert.

To test KSM's sleuthing ability, we performed a series of actions mimicking suspicious behavior. We added a user with administrative rights, altered some files, and deleted the user a few minutes later. In response, KSM immediately sent an audible alarm to the console and logged the incident. You can configure the program to notify you by e-mail or pager as well. KSM reacted similarly when we disabled the security log and simulated an unsuccessful hack by typing a series of incorrect log-ons in rapid succession.

KSM offers stronger reporting features than RealSecure. It includes 35 canned reports, ranging from Most Targeted System to quarterly summaries of all security breaches. You can save the reports, export them to a Microsoft Word or Excel file, or save them in HTML to post on your intranet. There's even a runtime license of Crystal Reports for generating custom reports.



JUST THE FACTS: *Kane Security Monitor provides a no-nonsense administrative GUI that's also easy to use.*

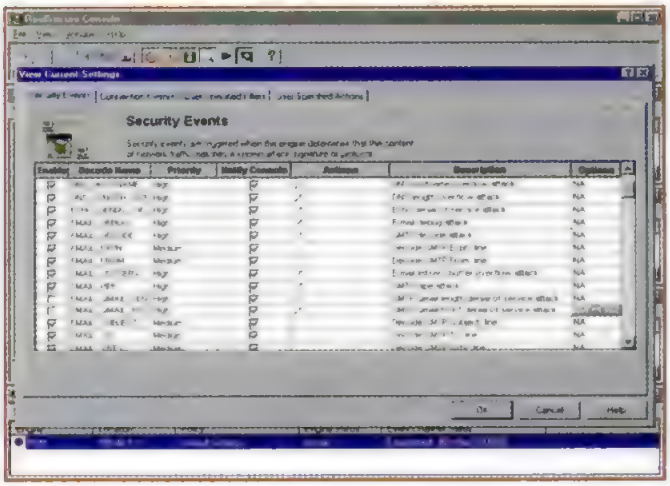
Intrusion Detection offers volume discounts for larger orders. Though $1,500 per server isn't cheap, it's roughly one-sixth the cost of RealSecure. In addition, KSM doesn't require deployment of any additional systems (as RealSecure does), which digs deeper into your pocket. The company's support plan includes round-the-clock technical support, and it provides one year of quarterly software updates for an additional 20 percent of the purchase price.

Kane Security Monitor. List price: $1,500 per server. Requires: Windows NT. Intrusion Detection Inc., New York; 800-408-6104, 212-348-8900; fax, 212-427-9185; www.intrusion.com. *Choose 901 at www.pcmag.com/infolink.*

Internet Security Systems Inc.

RealSecure 2.0

To combat network intrusions, you may need to pack something more powerful than a warning. RealSecure 2.0 from Internet Security Systems tracks network infiltrators, but also can break their connections, putting a swift end to mischief. This power comes at a fairly high price ($8,995 list per monitored network segment), but compared with Kane Security Monitor, this product gives you your money's worth. And like Intrusion Detection, ISS offers around-the-clock technical support for an additional 20 percent of the purchase price.



DO I KNOW YOU? *RealSecure triggers a security event when a user's behavior matches a database entry of known hacker attacks.*

The product consists of the RealSecure Engine and the RealSecure Console. To use it, you load the engine on a Windows NT server sitting on the network segment you want monitored. You'll get the best results on a beefy server; we recommend at least a 200-MHz Pentium II with a minimum of 128MB of RAM.

Installing RealSecure was fairly easy, but configuring the engine required a strong familiarity with the IP services running on the network. Without it, you may wind up with more (or less) information than you need or desire. In developing our configuration, we found the engine's default settings a good place to start.

The engine acts as a packet sniffer and compares every packet traveling over the segment to a database of known attack patterns. Upon finding a match, RealSecure alerts the console with an audible alarm. In testing, this packet inspection had no visible effect on network performance.

To test RealSecure, we ran ISS's Security Scanner on our network. This application simulates a variety of hacker attacks. RealSecure alerted us that the attacks were occurring and traced them to the originating IP address.

What makes RealSecure a cut above KSM is its security policies. You can configure these to break the offending IP connection, log the attack, and alert you via an e-mail or a pager. RealSecure comes with six predefined policies, and you can create countless others. Moreover, you can integrate them into Checkpoint's Firewall-1; this lets you reconfigure the firewall's policy and configure your overall network security policy from one console.

Although the product offers fewer canned reports than KSM,

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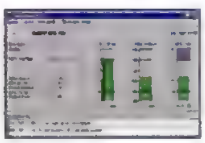

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they were useful in providing information on a number of attempted attacks, and on connections killed and by whom. The included copy of Crystal Reports lets you view reports in graphical or text-based formats, save them for later retrieval, or export them to other popular third-party applications.

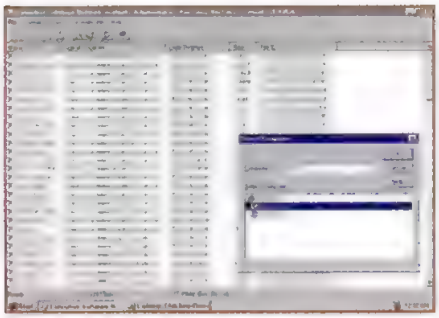
RealSecure 2.0. List price: $8,995 per monitored segment. Requires: 16MB RAM, 25MB disk space, Microsoft Windows NT. Internet Security Systems Inc., Atlanta; 800-776-2362; 770-395-0150; fax, 770-395-1972; www.iss.net. *Choose 902 at www.pcmag.com/infolink.*

UNDELETE UTILITIES

Bringing Files Back from Beyond

By Arie Moller

Resurrecting deleted files from your system has just gotten easier. Network Undelete 1.0 lets you restore deleted files from a Windows NT 4.0 system using a local client ($40 street) or remotely using the administrator version ($150 street) with the client.



BRING THEM BACK: *Network Undelete lets you retrieve a deleted file from another client.*

Although we liked Network Undelete's convenience, the utility put a heavy strain on system and network resources. When we performed a file search or selected Undelete from Disk remotely, the product utilized 70 percent of our 300-MHz Pentium II system's resources, and it used 20 percent of our 10-Mbps Ethernet network.

We found the program easy to use. On installation, Network Undelete renames Windows NT's Recycle Bin the Recovery Bin. Clicking on the Recovery Bin opens the application's main window, which displays a list of deleted files. Right-clicking a file provides the option to recover it, delete it, or subsequently exclude the selected file type from the Bin. And if you can't locate a particular file, Network Undelete lets you scan all of the client's hard disks to locate it.

In addition, Network Undelete includes a powerful feature called Undelete from Disk, for recovering files already deleted from the Recovery Bin. Bringing a file back from the dead this way is possible only if you own it or have administrative rights to perform the task remotely. We tested Undelete from Disk by deleting files in a number of ways: from the command prompt, from Explorer, and even using Norton Uninstaller. In each case, we recovered our files.

Two minor glitches detract from the product. The administrator and a user can't have Network Undelete open simultaneously. If the client's application is open, the administrator version hangs while attempting to connect to the client. And if you move a file from a client on the network to another system, the product interprets your action as a deletion and puts a copy of the file in the originating system's Recovery Bin.

Network Undelete 1.0. Street price: Administrator, $150; clients, $40 each. Requires: 8MB RAM, 1MB hard disk space, Microsoft Windows NT 4.0 with Service Pack 3, VGA video or better. Executive Software, Glendale, CA; 800-829-6468; www.networkundelete.com. *Choose 903 at www.pcmag.com/infolink.*

ONLINE BACKUP

Backup, Over and Out

By Steve Rigney

Traditionally, backing up data from remote and mobile users to your corporate LAN has often involved long sessions over a slow dial-up connection. But new products from Connected Corp. and CoreData make regular backup sessions fast and easy by compressing files before transmitting them to the backup server.

Connected's Connected Online Backup 3.2 (COB) and CoreData's RemoteWorx employ essentially the same methods of data encryption and compression, but that's where the similarities between them end.

Connected Corp.

Connected Online Backup

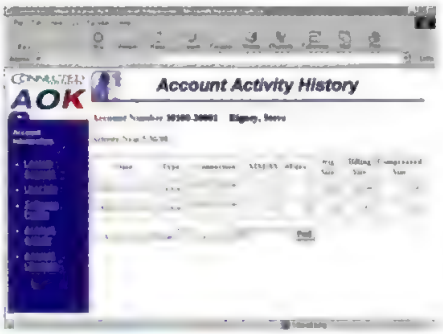
Primed with the knowledge that enterprise environments often need more than a bare-bones backup solution, Connected Corp. recently released Connected Online Backup (COB) 3.2. The product offers enterprise-level redundancy and scalability at an enterprise price ($20,000 list for the Data Server and Backup Engine and $189 list for each Windows 95 or NT client). If you can live without some of the features provided here, consider RemoteWorx instead. You'll get the same basic backup capability for one-tenth the cost.

In addition to the license investment, COB requires a high-end Windows NT server equipped with RAID Level 5 and a DLT autoloader, as well as Microsoft SQL Server 6.5 and Microsoft Internet Information Server (free with Windows NT). To bullet-proof the solution further, Connected offers a server-mirroring feature ($109.95 list) that ensures you'll always have access to your data.

After we got the server up and running, we used COB's Corporate Deployment Kit to create custom client agents, which we then distributed to our test PCs as e-mail attachments. The Windows 95 or NT client agent defines your server rights (such as the number of times you can back up the client) and the amount of server disk space allotted. Although the kit is handy, we preferred RemoteWorx's Auto Client Installer ($2,495 list), which distributes agents directly to the clients.

To back up your files, the agent first scans the hard disk for changes made since the last session. COB uses Connected's Delta Block technology to scan the hard disk block by block, a faster approach than RemoteWorx's byte-by-byte method. Upon detecting an altered block, the agent records the changes, compresses them, and then encrypts them before passing the data on to the server. You can choose either 56-bit DES or Triple DES encryption schemes upon purchase.

COB's browser-based management tool is fairly basic, but it let us keep tabs on all of our users. Plus, it includes a helpful knowledge base for troubleshooting problems.



ONLINE MANAGEMENT: *Connected Online Backup's HTML-based interface provides you with basic user and job information.*

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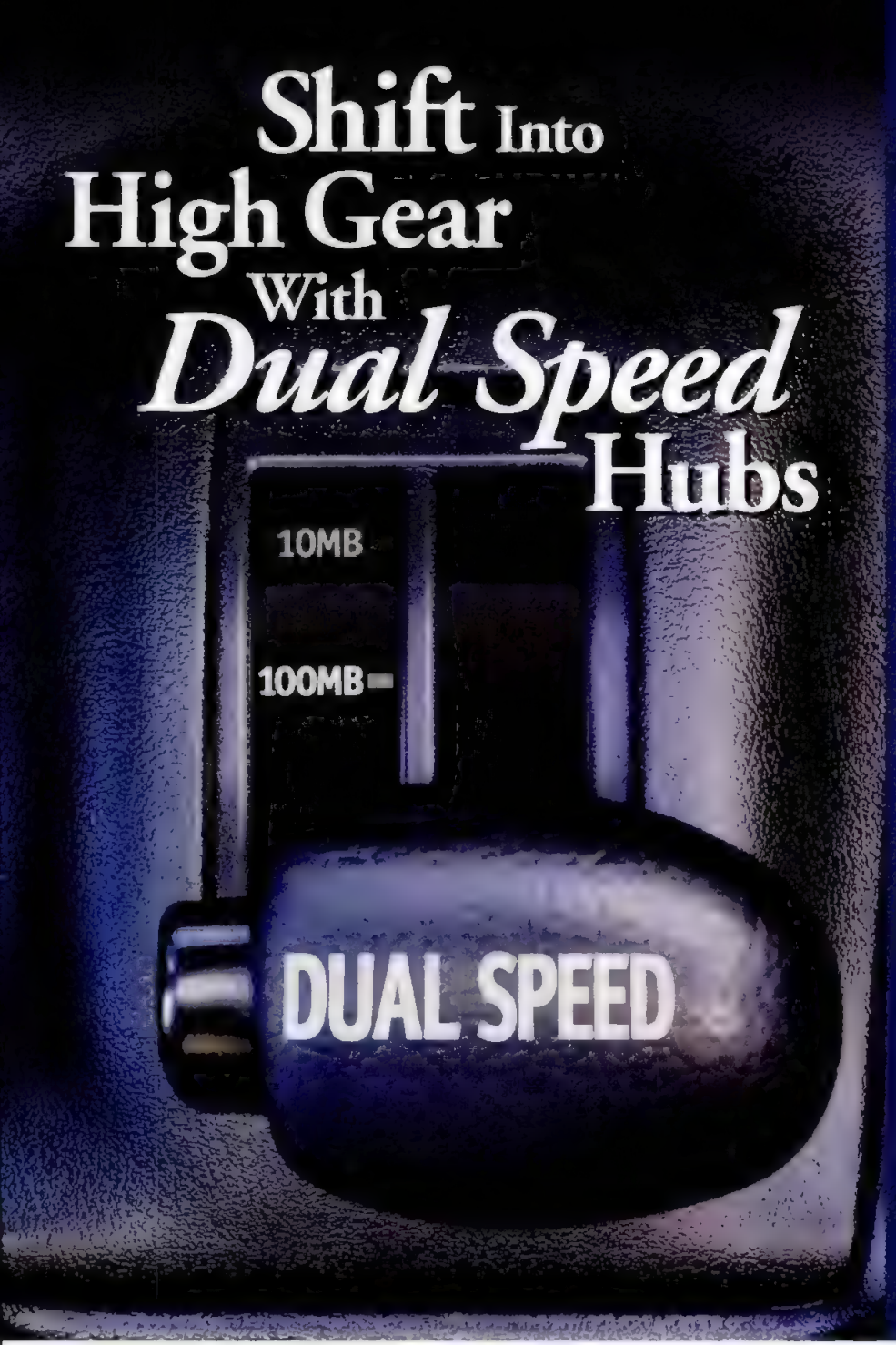

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Connected Online Backup 3.2. List price: Server, $20,000; client, $189. Server requires: 233-MHz Pentium processor or better; 128MB RAM; 24GB RAID Level 5 storage; DLT autoloader; Microsoft Windows NT, Internet Information Server, SQL Server 6.5. Client requires: Microsoft Windows 95 or NT. Connected Corp., Framingham, MA; 800-353-3078, 508-270-0000; fax, 508-270-0033; www.connected.com. *Choose 904 at www.pcmag.com/infolink.*

CoreData

RemoteWorx

Although RemoteWorx 2.1 doesn't provide the enterprise bells and whistles of Connected Online Backup (COB) or its easy scalability, this program performs the same remote and local file backup and restore for nearly one-tenth the price (starting at $1,695 list for a ten-user license). We found RemoteWorx easier to install than COB and faster in across-the-wire transfers, and it's priced with small and medium-size businesses in mind.

The server package runs on a Pentium-based Windows NT server. All it requires is a decent amount of RAM (we used 256MB) and enough disk space for all of your users' data.

The RemoteWorx administration program runs on a Windows NT server. It lets you set up users and security, as well as generate reports on backups and restores. Although similar to the COB administrator, it provides fewer controls; it can't assign user space quotas on the server's hard disk, for instance.

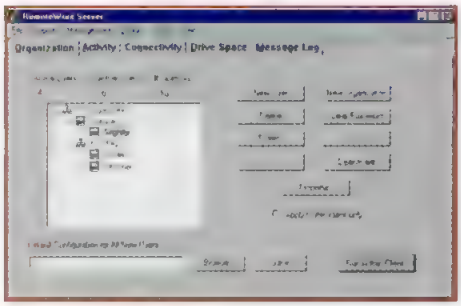
The RemoteWorx client runs on Windows 95 and NT and is similar to COB's in appearance and ease of use. Within minutes of its installation, we were selecting files for backup and scheduling a time for the file transfer. We especially liked RemoteWorx Auto Client Installer ($2,495 list), which distributes the clients through a dial-up or network connection. Connected should consider adding a similar mechanism to COB.

Like the COB agent, the RemoteWorx client scans the hard disk for changes, compresses the data, and then encrypts it using the CD64 algorithm (the process is comparable to COB's DES and Triple DES encryption) before passing it along to the server.

COB and RemoteWorx use different methods for scanning the client's hard disk for changes: RemoteWorx scans the hard disk byte by byte; COB scans block by block. Because bytes are much smaller than blocks, byte scans take up to three times as long to perform.

One drawback: When RemoteWorx finishes a backup, it leaves a signature file on the hard disk equal in size to the transmitted data. COB's signature file, by contrast, is only a fraction the size of the most recent backup.

RemoteWorx 2.1. List price: 10-user license, $1,695. Server requires: Pentium processor or better, 32MB RAM, Microsoft



MANAGEMENT MADE EASY: *RemoteWorx's server-administration GUI provides a clean interface for managing your backup-server tasks.*

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CONNECTION UTILITIES

You Can Take It with You

By Bill Ulrich

With Network/Unplugged ($109 list), Mobiliti just made the mobile user's life a little easier. This Windows 95 utility lets you take files and folders from the network using any major network protocol (such as Microsoft Networks, NetWare, NFS, or LANtastic,) and store them in a *virtual network* cached on your laptop. Gone are the days of pulling down files and storing them on a floppy disk, or e-mailing them to yourself to work on the files off-line.

The program takes up only about 2MB of disk space. To configure the virtual network on our IBM ThinkPad 560 (with a 100-MHz Pentium processor, 32MB of RAM, and a Xircom 10Base-T network adapter), we selected the files and folders we wanted from the network and put them into logical groupings called Projects. The program then cached the files on our laptop.

When we disconnected the ThinkPad from the LAN and tried to access a network drive, the application first checked to see whether we had a LAN connection before it redirected us to the cached file. This made our ThinkPad always appear connected to the network. This is a useful feature to have when your applications depend on maintaining a shared mapped drive.

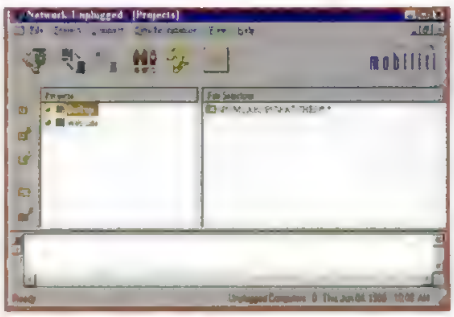
Net Tools
FROM THE BENCH

Upon reconnecting to the LAN, we synchronized our local files to the network copies with a push of a button. The program scanned the local and network files to see whether any changes had been made, then displayed the results. From the list, we simply chose which files to upload or download to bring our local files into sync with those on the network.

When we tried to overwrite a file that was out of sync, the program offered options to overwrite the network file with the local copy, overwrite the local file with the network version, or delete or rename either file.

A feature we'd like to see in a future version is a file-transfer mechanism that transfers only a file's changes (not the entire file) or adds simple file compression to speed up the synchronization process.

Network/Unplugged. List price: $109. Requires: 486-based PC or better, 8MB RAM, Microsoft Windows 95, network connection. Mobiliti Inc., Edison, NJ; 732-603-8592; fax, 732-603-8593; www.mobiliti.com. *Choose 906 at www.pcmag.com/infolink.* PC



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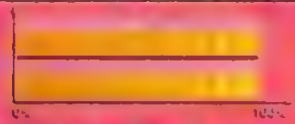

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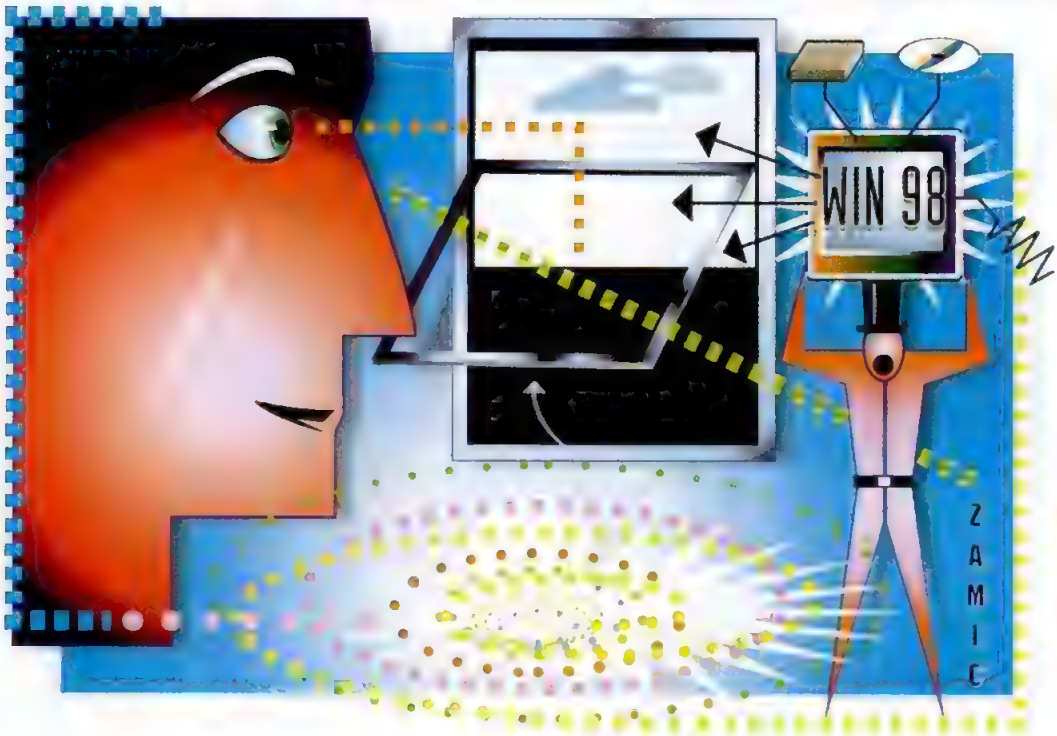

ILLUSTRATION BY RENE ZAMIC

Inside Windows 98

A technical overview of Microsoft's newest operating system.

By Keith Pleas

The core architecture of Windows 98 is relatively unchanged from Windows 95. Most of what's new comes in the form of extensions to Microsoft's Win32 platform, such as the Winsock 2.0, WinInet, and Crypto APIs, and of products built using those new Windows extensions, such as NetMeeting, NetShow, and even Internet Explorer. Of course, there are a number of small improvements, which we'll discuss in some detail, but, in general, the necessity for backward compatibility with the huge Windows 95 installed base, plus the fact that Windows 98 is the last planned revision to this branch of the Win32 operating system, meant that changes would be evolutionary.

The Windows 98 operating system, like Windows 95 before it, provides a complete 32-bit base system that includes a Virtual Machine Manager (VMM), an Installable File System Manager, configuration management for Plug and Play, and other necessary system services (see the diagram "Windows 98 System Architecture"). The VMM creates and manages a single virtual machine (VM) that contains all Win32 applications (and the Win32 subsystem) as well as additional VMs for DOS applications that require exclusive access to machine resources. The VMM includes a Windows NT–compatible scheduler and provides support for preemptive multithreading of Win32 processes, each in its own private address space (which is accomplished through paging). The base system also manages the dynamic, shrinkable swap file as well as the loading and unloading of device drivers and network protocols on an as-needed basis. Overall, this approach allows Windows 98 to be more robust by isolating application code from system code.

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You'll find all of the articles, examples, and code files in this section at PC Tech Online.

In all 32-bit Microsoft operating systems (Windows 9*x*, Windows NT, and Windows CE) a *process* is an

INSIDE

TUTOR: The new OS on the block includes a useful reporting tool: Microsoft System Information Utility. Msinfo displays your system's under-the-hood information in one window and provides access to configuration utilities. It will even create a report you can send to a support technician via e-mail. *Page 336.*

UTILITIES: HandsDown makes downloading files from the Internet more convenient. It uses the Windows Clipboard to create a list of files for downloading from FTP or Web servers. You can download the files all together at a convenient time or save the list for reuse later. *Page 347.*

PC SOLUTIONS: Introducing the Windows Scripting Host, Windows 98's answer to batch files; other handy utilities from the Windows 98 Resource Kit; applying gradient fills to title bars; using SCSI to copy CDs to CD-RW disks; changing the Windows 3.1 start-up logo; and more. *Page 361.*

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instance of an application with at least one running thread. Each process has its own 4GB address space, which contains the executable and any DLL code as well as any global and static data. Each process also owns its files, memory allocations, and threads. When a process terminates, any remaining threads in the process terminate, all of its user and GDI objects are freed, and all of its kernel objects are closed.

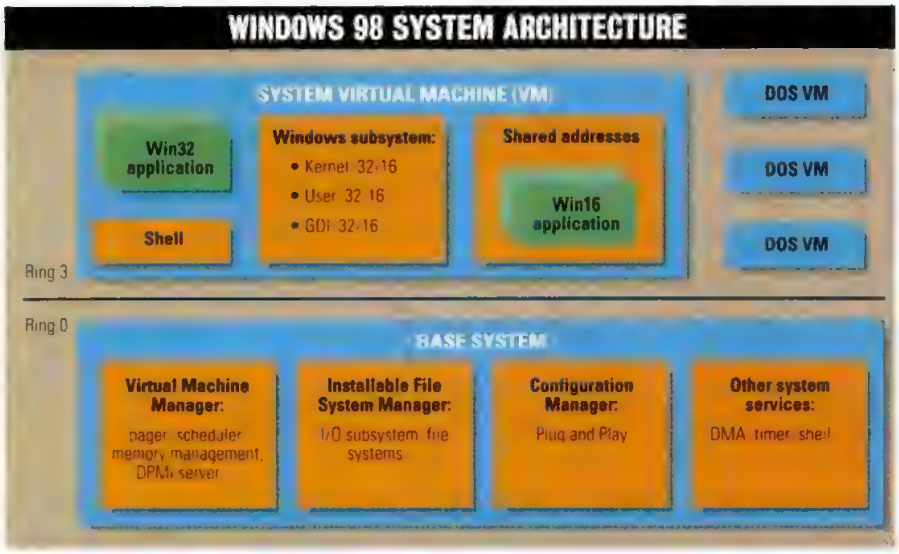
A *thread* is a single path of execution within a process. Each thread has a set of CPU registers, has its own stack in the process's address space, and executes code contained in that process's address space. When a thread terminates, all of the user (window and hooks) objects it owns are freed. When the last remaining thread in a process terminates, the process itself is terminated.

For a variety of reasons, including compatibility, performance, and code reusability, Windows 98 was designed so that each of its core components—user, kernel, and GDI—is implemented in two DLLs, providing both a new 32-bit interface and a legacy 16-bit interface. A process called *thunking* is used to go between the 32-bit and 16-bit code, and each function may actually exist in either the 16-bit or 32-bit DLL, or in both. While the Windows 98 kernel is mostly newer 32-bit code, most of the user component, which handles the windowing system in the user interface, is still 16-bit. In general, the distribution of code between the 32-bit and 16-bit core DLLs is transparent to applications.

Robustness in Windows 9*x* is also substantially improved over 16-bit versions. In particular, better parameter validation of Windows APIs turns away many coding errors before they have a chance to hit the operating system. An asynchronous input model, which gives each thread its own posted message queue and virtualized input queue, means a thread that hangs won't prevent input (keystrokes, mouse messages, and so forth) from reaching other threads. And since objects are tracked by process and by thread (as explained above), Windows 9*x* also clears any resources that haven't been freed when a process terminates. In fact, even 16-bit applications will have unfreed resources cleared when no other 16-bit applications are running.

Almost as important as increased robustness is increased capacity. Windows 9*x* was designed to handle substantially greater numbers of system resources. The (unchanged) system-wide resource limits in Windows 98 are:

- Windows menu handles—32K;
- timers—unlimited;
- COM and LPT ports—unlimited;
- items per list box—32K;
- data per list box—unlimited;
- data per edit control—unlimited;
- regions—unlimited;
- physical pens and brushes—unlimited;
- logical pens and brushes—all in 64K segment;
- logical fonts—750-800;
- installed fonts—1,000;
- device contexts—16K.



CORE IMPROVEMENTS

Microsoft has had several years since first shipping Windows 95 to investigate and implement improvements to the core operating system. In a couple of cases, such as FAT32, these were incorporated into the OSR2 update to Windows 95. With Windows 98, however, Microsoft was able to make a number of performance-oriented improvements, primarily in disk and memory management, to enable applications to run more efficiently. Windows 98 delays loading some unnecessary components (like Vredir.vxd on systems that don't ask for real-mode network support) and moves locked code to pageable code in others (as for Vnbt.386). In addition, a new idle-time paging feature writes data to the swap file when the system is not busy.

Overall, Windows 98 has better memory management than Windows 95. You can verify that yourself by looking at swap-file usage using the System Monitor utility. In particular, you should compare the *Swapfile in use* item in the *Memory Manager* category.

Other core improvements have been made in the following areas:

Launching applications—The biggest bottleneck in launching applications is typically disk I/O. Specifically, where a 4K (the cluster size in FAT32) sector read might take 2 ms, a seek to another cluster might take 12 ms, about six times as long. Obviously, an important goal is to minimize the number of seeks required in launching an application. However, since clusters are not normally loaded contiguously, it's necessary to reorder the clusters in a file for best performance. Optimizing an application requires three steps:

1. Generate a disk trace during the application launch.
2. Generate a cluster-move list to reorder the clusters.
3. Run Disk Defragmenter using the move list.

To do this, Windows 98 has Taskmon.exe, a small, continuously running program that hooks `CreateProcess`. When Taskmon detects a process being started, it checks the registry to see if the application has already been optimized. If not, Taskmon loads Fiolog.vxd, which performs the disk trace (even catching reads from cache) and writes out a log file to the hidden folder %windir%\applog. Fiolog.vxd unloads automatically after 10 minutes with no activity. The next time the Defrag utility is run, the application's clusters are automatically optimized. Under optimum conditions (that is, on a disk with 4K clusters), this reordering can cut an application's load time by more than half. The only caveat is that the logging process itself can slow the launch process by about 7 percent the first time an application is launched. Subsequent launches show no measurable impact.

MapCache—An important performance enhancement in Windows 98 is the ability of a process to run code directly from the system's disk cache, rather than having to copy it first into the process's virtual address space. This enhancement, called MapCache, allows the process to use a pointer to the code in the disk cache and eliminates the duplication of having that code both in the disk cache and in process memory. It also eliminates the system overhead of actually performing the memory copy. Since code is being executed directly

from cache, cache sizes are generally larger and process memory is smaller than in Windows 95. Note, too, that since networking, disk, CD-ROM, and paging caches are all integrated, caching and thus performance will scale better with more memory.

WinAlign—Since memory in Intel *x*86 chips, and thus Windows 98, uses 4K pages, this means that for MapCache to work, the code pages in the disk cache must be aligned on 4K boundaries. However, executable files are commonly compiled with 512-byte boundaries, which means there is only a 1:8 chance that a particular page can be mapped from cache. Microsoft developed the WinAlign utility to restructure an executable file's sections along 4K boundaries, so that they align with 4K memory pages.

WinAlign rewrites the file's headers, then writes a new section table followed by the file's sections, each one starting on a 4K boundary. It then updates the new section table and, if debug symbols are present, concatenates them to the end of the file. Lastly, it updates the header to indicate that the file is now aligned on 4K boundaries and updates the file's dates accordingly. The result is a slightly larger file. WinAlign writes both the file's original and aligned section information to the registry, which can then be used to reconstruct the original file if necessary. (Since the file may previously have been aligned for some other purpose concatenating the sections back together is not sufficient.)

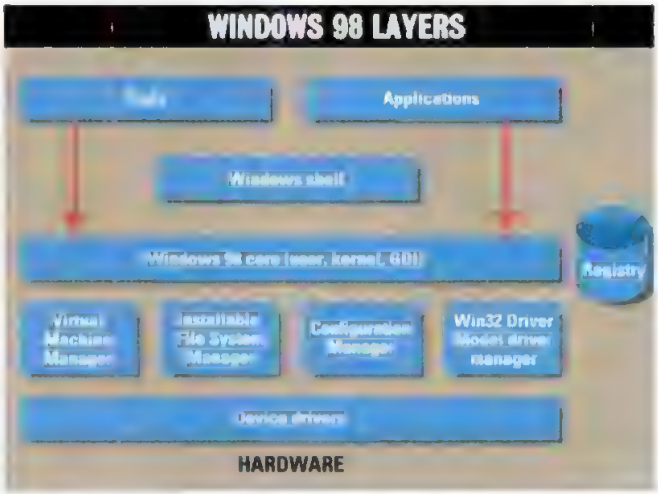
Because WinAlign physically changes the contents of a file, it should not be used with files that depend on exact byte ordering. For instance, you should not use WinAlign on patch files, files for which checksums might be required (such as self-extracting Pkzip archives), antivirus programs, or digitally signed files (which would cause verification to fail). In fact, WinAlign examines a file's header and will detect and ignore digitally signed files as well as Windows NT system files.

All binaries (executables and DLLs) that ship with Windows 98 come prealigned. Additionally, Windows 98 Setup checks for and aligns Microsoft Office files. Setup also adds WinAlign to the Task Scheduler and sets it to run every month as *Tune-up Application Start*. Microsoft has directed application vendors and its own product teams to align their binaries for future versions.

Registry—The system registry has always been a weakness as well as a strength of Windows, but several small changes in the way Windows 98 deals with the registry should help address the most serious problems. As a centralized, systemwide repository for every kind of user, software, and system setting, the registry replaces INI files and offers faster and more controlled access to settings that can be maintained on a per user basis. And unlike INI files, the registry can contain a variety of text or binary data types. Access to the system registry—even if indirect, by an end-user tool like RegEdit—is provided by the registry functions in the Windows API, and these functions can be used against registries opened on remote machines. While the remote viewing and manipulation of registries is normally done by a system administrator, often running Windows NT, it's possible for a Windows 98 user to examine registries on other machines after installing the remote registry service (Remotereg) from the \Admin\Nettools folder of the installation source.

Changes to the registry include more speed and robustness.

Changes to the registry from Windows 95 include more speed and robustness in the underlying registry functions as well as better optimization of in-memory data structures. In particular, a new mechanism for calculating a checksum when writing registry changes to disk dramatically improves registry changes by reducing the number of page faults.



But by far the biggest improvement to the Windows 98 registry is the addition of the Registry Checker utility, which is provided with both a Windows (ScanRegW) and command shell (ScanReg) interface. Every time the computer is started, the Registry Checker scans the registry looking for "inconsistent structures." This utility also backs up the registry once a day. If the Registry Checker finds a problem, it first tries to restore the settings from a good backup. If that's not possible, the utility attempts to fix the problem itself. The Registry Checker also watches for excess free space in the registry and automatically compacts the registry if the excess becomes too large, thus reducing boot time and improving memory use and performance. When backing up the registry, this utility creates a compressed CAB file in the Sysbckup directory that includes User.dat, System.dat, Win.ini, and System.ini. Users can also run ScanReg or ScanRegW interactively to back up the registry more often than the default of once per day and can change several of its options (located, ironically enough, in the Scanreg.ini file). The default number of rotating backups is five; the user can change that as well as specify the folder to hold the backups and specify additional files to be included in the backup.

Faster start-up and shutdown—Microsoft determined that, on most machines, more than half of the boot up time was spent in the BIOS POST (power-on self-test). In addition to working with hardware vendors to dramatically reduce POST time by using the Simple Boot Flag Specification of the OnNow design initiative, Microsoft also worked to eliminate loading unnecessary drivers and even eliminated the Windows 95 2-second, F8-key boot delay (now you hold the left Ctrl key down while booting). Overall, the boot time for Windows 98 itself is about equal to Windows 95, even though the new version has more features.

For shutdown, Microsoft eliminated the uninitializing of drivers, which in any case would have to be reinitialized when restarting, and worked to speed flushing the disk cache (without, of course, losing any data). Overall, the shutdown time on a typical network machine should drop from around 20 seconds under Windows 95 to less than 5 seconds under Windows 98.

Drivers and devices—Windows 98 has added support for a wide range of new devices. In fact, it is likely that more effort was devoted to increased hardware support than to any other area in Windows 98. In addition to supporting APM 1.2, the Advanced Configuration and Power Interface (ACPI) specification (proposed by Intel, Microsoft, and Toshiba) for standardized power management on PCs, support has been added for an

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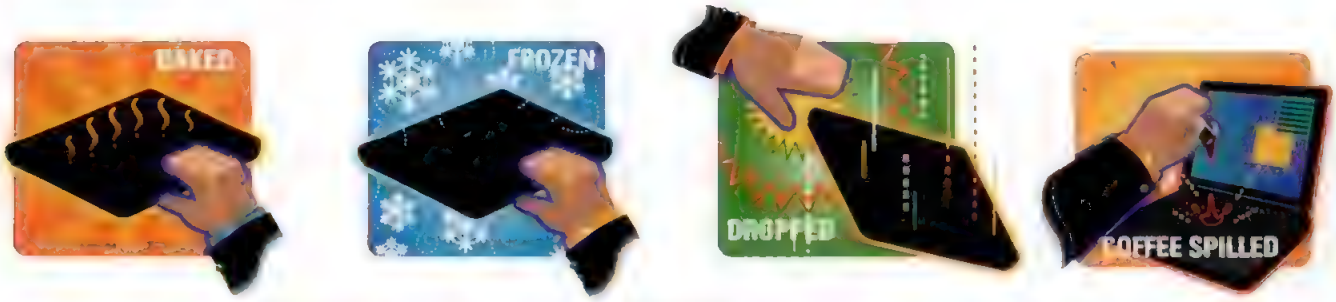

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alphabet soup of new hardware device technologies such as IrDA, USB, HID, IEEE 1394, AGP, ICM, and DVD. Support for these devices is provided by the driver layer between the core operating system and the hardware itself (see the diagram "Windows 98 Layers").

While Windows 98 still supports the Universal Driver and Virtualization Driver (VxD), the new Win32 Driver Model (WDM) has been added with an eye toward providing driver compatibility with Windows NT by isolating hardware-specific functionality in the driver from functions specific to individual operating systems. This allows a WDM driver to run on more than one operating system. In Windows 98, WDM support was provided by building a limited set of Windows NT kernel services into a virtual device driver, Ntkern .vxd. WDM-compatible device drivers included with Windows 98 provide support for the new devices mentioned above.

Networking—Networking services have been expanded in several ways for Windows 98. In addition to built-in client support for virtual private networks (VPNs) using Point-to-Point Tunneling Protocol (PPTP), Windows 98 includes Network Driver Interface Specification 5 enhancements for connection-oriented networks like ATM and ISDN. Dial-up scripting (found previously in Microsoft's Plus! add-on) has been incorporated, as has multilink channel aggregation, for combining multiple communications channels, such as two ISDN B-channels. And a new TCP/IP feature, especially useful for laptops, is automatic private IP addressing, which assigns an IP address only if a DHCP (Dynamic Host Configuration Protocol) server isn't available.

Multiple monitors—Windows 98 (and Windows NT 5.0) supports multiple display devices and monitors on a single system. This support, often called *MultiMon*, allows Windows 98 to use the display area from two or more PCI display devices (and attached monitors) to create a single logical desktop. A user can display applications on either monitor or can even drag windows between monitors. Additional display enhancements that were previously part of Plus! have also been incorporated.

NEW WIN32 BITS

Instead of adding new functions to the core Windows component libraries (user, kernel, and GDI), Microsoft in recent years has been adding new functionality to its operating systems either by adding new APIs or, more recently, by exposing new COM services. This new functionality has also tended to ping-pong back and forth between Windows 9*x* and Windows NT, depending on the timing of major releases, with the recent Windows NT Option Pack being a notable exception.

Internet—With Windows 98, Internet Explorer is now clearly a part of the Windows 9*x* operating system. What may not be so obvious is that all of the many related technologies—the common Internet-based protocols HTTP and FTP and standards like HTML, DHTML, and XML, along with a Java VM—are also now part of the platform. Under the hood, Internet Explorer is really just a wrapper to functionality implemented in system components like Shdocvw.dll and Wininet.dll (see Figure 1). That means other applications are now able to incorporate the browsing and HTML rendering capabilities of Shdocvw or call Wininet itself to perform HTTP and FTP transfers directly. Of course, developers can also use the new features in Winsock 2.0 (see below), but many will be satisfied with the higher-level abstractions in these intermediate components and will use them to build HTML-based documentation, file transfers, and Web links into their applications.

FIGURE 1: *Protocols and standards have been integrated into the platform, making them available to a variety of programs.*

CryptoAPI—Windows 98 also includes secure communications, digital certificates, and public/private key encryption built on Microsoft's layered CryptoAPI. This technology is used, for instance, by Microsoft Wallet, an optional component of Internet Explorer. It is also used to set up SSL connections, verify digital certificates on files transferred across the Internet, and digitally sign e-mail using mail clients such as the included Outlook Express. The default Cryptographic Service Provider stores information in the registry, but third-party providers can enhance security with other methods, such as smart cards.

DirectX 5—This set of APIs gives applications, typically games, direct access to the system's multimedia hardware. DirectX 5 consists of the following components:

- Direct3D is the interface to the 3-D graphics capabilities in display drivers.
- DirectAnimation combines different media for dynamic presentations.
- DirectDraw provides fast 2-D graphics using hardware acceleration capabilities in the video adapter. It is also used for handling multiple display devices.
- DirectInput processes input from joysticks and future Windows input devices.
- DirectSound provides access to a sound adapter's mixing and playback.
- DirectShow (formerly called ActiveMovie) enables capture and playback of multimedia streams.

Winsock 2.0—Windows Sockets (Winsock) is an industry standard that allows Windows systems to communicate over a network with Windows-based systems and others (such as Unix) that also support Berkeley sockets. Windows 95 shipped with Winsock 1.1, which was limited to TCP/IP and supported only synchronous operation. Windows 98 ships with Winsock 2.0 (Windows 95 can be upgraded with Wsockupd.exe from Microsoft's FTP site), which includes a number of feature enhancements. In addition to multiprotocol support over non-TCP/IP networks, Winsock 2.0 uses a layered provider architecture to provide asynchronous, event-based notification; quality of service (QoS) support for bandwidth, latency, and delay; service name registration and discovery; and multipoint (including multicast) capabilities. Windows 98 installs Resource Reservation Protocol to handle QoS requests, reserving and then monitoring network bandwidth when possible and if requested. NetMeeting takes advantage of multipoint for data conferencing, and NetShow uses multicast to receive real-time multimedia streams.

DCOM—Distributed COM, originally Network OLE, first shipped with Windows NT 4.0 and was later made available for Windows 95. Essentially, DCOM allows components to interoperate over an RPC-based network. Settings, including on which machine the component should be run, are stored in the registry and can be configured manually with Dcomcnfg.exe. Somewhat confusingly, Microsoft still refers to OLE rather than COM for applications integration.

UTILITIES AND ADMINISTRATION

As you would expect with so many new features, the administration of Windows 98 has become more complex. In addition to the Registry Checker discussed above, Windows 98 includes several new and improved tools for diagnosing and correcting the most common system problems:

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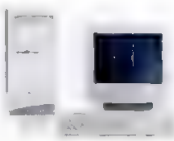

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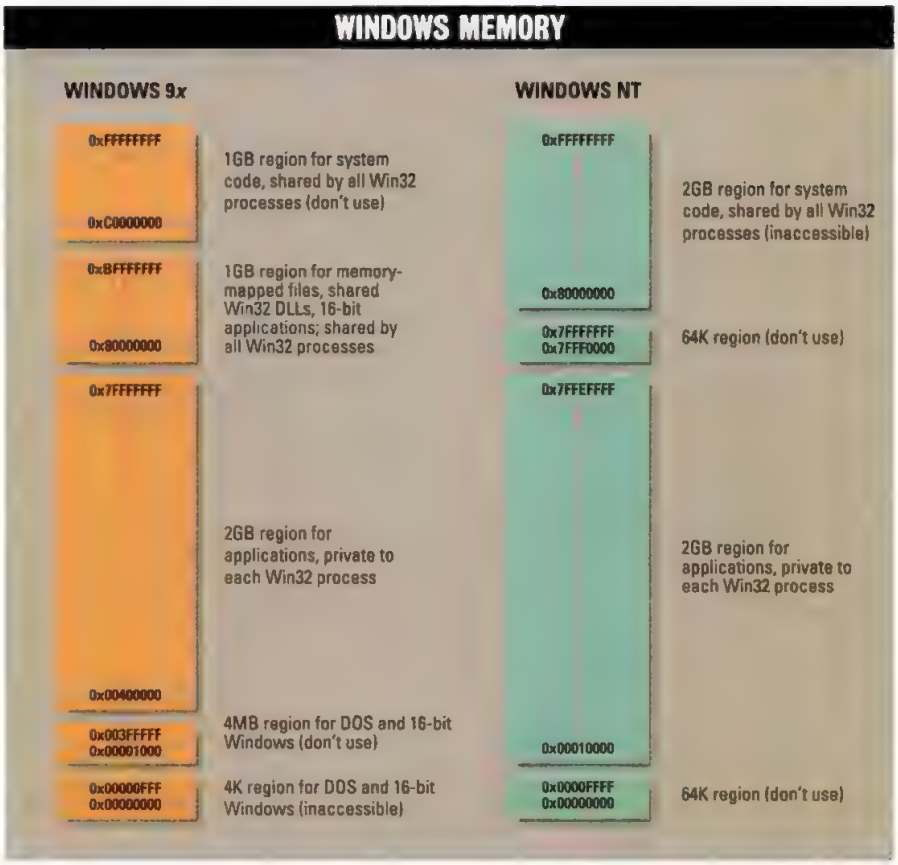

• System Information (Msinfo32.exe) contains substantially more information than the Windows 95 version, including everything from drivers (kernel, user-more, and DOS) to hardware and component settings, to system hooks. (This issue's Tutor column has more on Msinfo.)

• Dr. Watson (Drwatson.exe) collects information about software faults. The version that comes with Windows 98 has new configuration options and provides a convenient method for viewing log files.

• System File Checker (Sfc.exe) scans for altered system files and lets you restore files from your installation source. It works by calculating and comparing CRC checksums against a baseline stored in Default.sfc to determine whether a file was changed. Files and folders to be scanned are user customizable, as are restore options.

• Signature Verification Tool (Sigverif.exe) lets you browse for digitally signed (or unsigned) files (EXEs, DLLs and variants like OCXs, CABs, and Java JARs) and examine their certificates

• Automated Skip Driver (Asd.exe) detects device drivers that fail to load at start-up. Problem drivers are disabled and recorded in the Asd.log file.

• Version Conflict Manager (Vcmui.exe) addresses the problem you have when a program you're installing wants to install a component that is older (determined by file version number, not date) than one already installed on your system. If you choose to replace the file, then the installed file is moved into the %windir%\VCM folder with the extension changed to .000. You can then use the Version Conflict Manager, which shows those files, their backup dates, and both the backup and current file version numbers, to examine this directory and restore any necessary files rather than reinstall the program that depends on them. Unfortunately, while VCM eases Windows 98 setup, it doesn't work with other application installations.

• Microsoft Management Console (MMC) is the primary administration tool in Windows NT. MMC is a shell that contains snap-ins that perform administrative tasks. MMC is included with the Windows 98 Resource Kit, but Microsoft included only a single snap-in, the Windows 98 Resource Kit Tools Sampler, which is merely a launcher for a collection of unrelated, standalone configuration and administration utilities that don't run in MMC. Of course, you can also use MMC to view folders (for organizing), ActiveX controls, Web links, and monitor controls.

WINDOWS 98 VERSUS WINDOWS NT

With all that Windows 9*x* and Windows NT have in common, there are a number of important differences that will likely never be resolved. The most obvious difference involves the hardware platform itself: Windows 9*x* is limited to running on a single processor under the Intel *x*86 architecture, whereas Windows NT scales much better and supports symmetric multiprocessing on both Intel *x*86 and Digital Equipment Corp. Alpha hardware. Another difference is Windows 9*x* has very limited server support. For instance, Windows 9*x* does not support Windows NT services (or its Service Control Manager) or server-side named pipes. Windows 9*x* also doesn't do event logging. Even the file systems are incompatible—Windows NT uses NTFS, and Windows 9*x* uses FAT32—though Microsoft has said that Windows NT 5.0 will incorporate support for FAT32, and Windows 98 includes client software support for Windows NT 5.0's Distributed File System.

Many other differences between the two operating systems are apparent only to people who develop and support solutions that run under both systems. For instance, the 4GB process memory is laid out differently (see the diagram "Windows Memory"). For an application to load optimally on a specific platform, the executable and its components must bind to particular addresses, which are different for the two operating systems.

Another important difference is that Windows 98 is not as secure as Windows NT, nor could it ever be. In Windows NT, except for device drivers, access to system resources must go through the Win32 API, which includes security and access parameters that are ignored on Windows 9*x*. That includes all resources, from the file system (NTFS can be secured, FAT32 cannot) to the registry (not only can the Windows NT registry be secured, but entries within it can be encrypted) to objects in the system executive. Windows NT was also designed from the beginning for international distribution and thus supports the common Unicode standard throughout. Windows 9*x* uses a DBCS character encoding scheme most of the time and uses Unicode only for certain common components, such as the OLE DLLs, that it shares with Windows NT.

The one big advantage that Windows 98 has today is clearly in device support. With everything from image color matching to advanced modem control, Windows 98 is compatible with a much wider range of consumer-oriented hardware and software. PC

Keith Pleas is an independent author, developer, and trainer. He organizes and speaks at technical conferences and is a contributing editor of Visual Basic Programmer's Journal.

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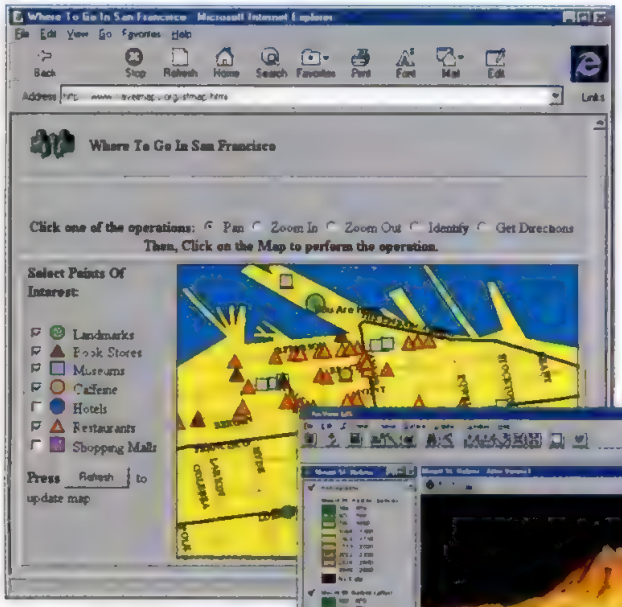

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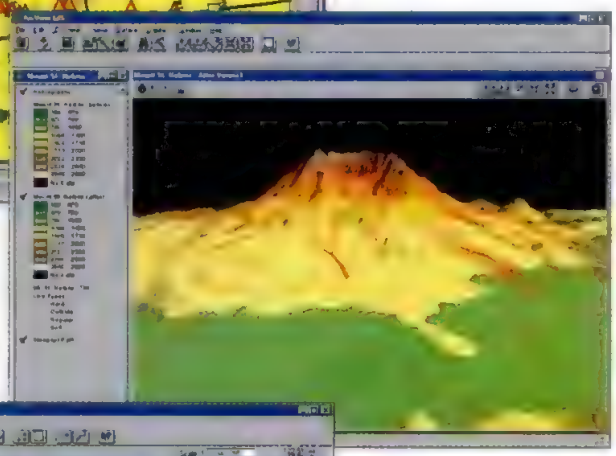

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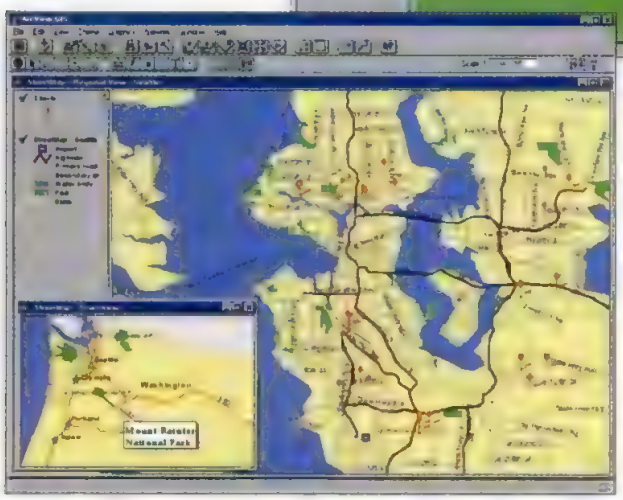

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Windows 98's System Information Tool

Msinfo gathers and organizes system data in one convenient place and throws in useful diagnostic tools.

By Neil Randall

System information can be inspected in Windows 95, largely through the System applet in Control Panel, but the operating system lacks a central, easy-to-read repository of this important data. Windows 98 addresses that problem with a useful little tool called Microsoft System Information Utility 4.1, otherwise known as Msinfo. You can get to it through the Accessories\System Tools folder, or by typing *Msinfo32* into the *Run* dialog, which you access from the *Start* menu.

Msinfo gathers all your under-the-hood information in a two-pane window. This window operates much like Windows Explorer's, with a collapsible hierarchical listing on the left and a viewing area for the details of the selected item on the right (see Figure 1). The left pane is divided into four main menus: *System Information*, *Hardware Resources*, *Components*, and *Software Environment*. We'll examine each in turn. Msinfo itself is not interactive. You can't change anything from within the window. The *Tools* menu, however, provides access to several utilities that do let you interact with the system. We'll also look at some of them later.

The function of Msinfo—obviously—is to display system details. The utility is aimed to some degree at users who want to attempt their own system repairs, but it is designed primarily for support technicians, either in your organization or at Microsoft. Msinfo includes a small utility, the Windows Report Tool, that lets you send the information to an e-mail address.

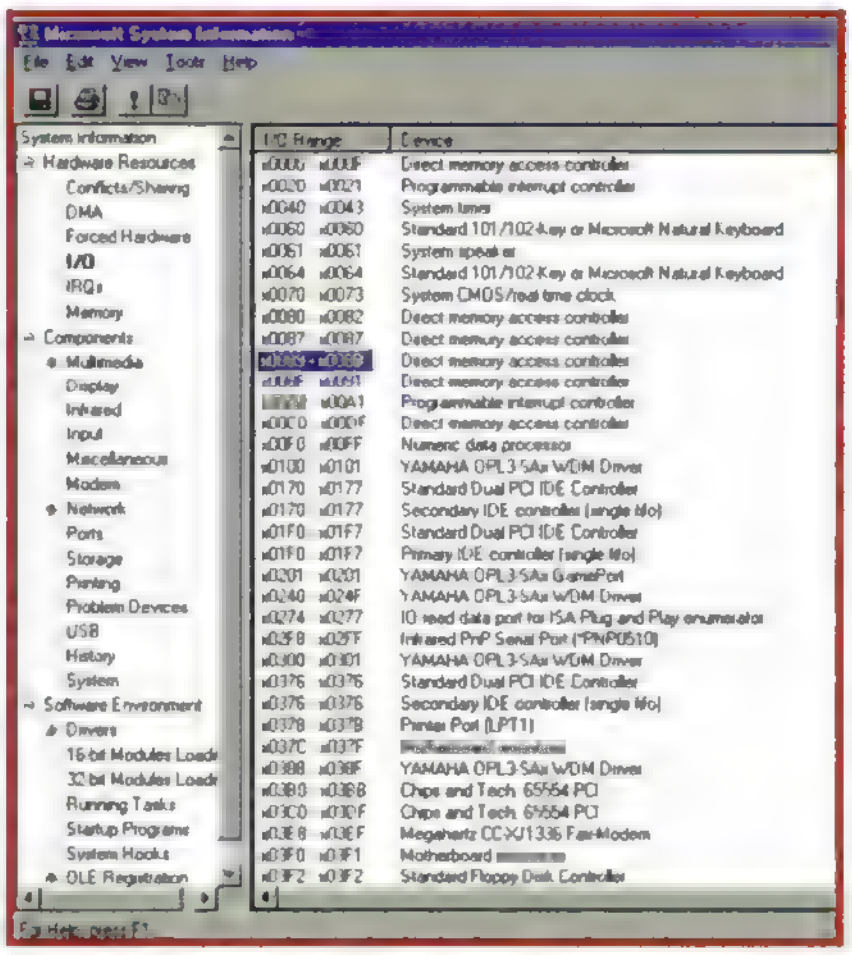

FIGURE 1: *Windows 98's Msinfo uses a viewing format similar to Windows Explorer's or the Registry Editor's, with item names on the left and data values on the right.*

SYSTEM INFORMATION

The only menu that's not collapsible is *System Information*. Here you'll find basic details about your system, including the version numbers of Windows 98 and Internet Explorer, the network name of your computer, and your *uptime*, or how long the system has been running. Uptime is expressed in days, hours, minutes, and seconds.

System Information reports several other details, including the size of your swap file and the amount of space remaining on the disk on which the swap file is located. Also shown are the percentage of system resources available, the number of megabytes of installed RAM, and the type of processor in your machine.

HARDWARE RESOURCES

The organizational usefulness of the new Msinfo becomes apparent with the *Hardware Resources* section. *Hardware Resources* is divided into six subsections:

• *Conflicts/Sharing* displays details about IRQ and other resources that are in conflict or are being shared. The system reports sharing by PCI devices, which are designed to support sharing. The listing shows the conflicting or shared resource on the left, with a description, on the right, of the device in question (complete with the name of the manufacturer, if it's available).

• *DMA* reports on direct memory access resources . You can find out which DMA channels are in use and put that knowledge to use in configuring peripheral cards that do not configure completely through Plug and Play. The report is a listing of the DMA channels and the devices using each channel. Also listed are free channels .

• *Forced Hardware* reports on devices that "force" their addresses onto the system. Sometimes, particularly with legacy hardware such as older modems and sound cards, Plug and Play doesn't work. Such cards get their resource assignments from jumper switches. Some network cards, even if they have no jumpers, can assume only a limited number of possible resource assignments, and a setup program establishes the IRQ and DMA settings when the system starts. Forced Hardware lists these devices and their assignments. The listing is of greatest use when a hardware component isn't working; you can see which forced hardware devices are taking up which resources, then scan Conflicts/Sharing to determine where the conflict occurs.

• *I/O* displays a long list of devices and the input/output ranges to which they are assigned. Typically, this will be of most use to system technicians trying to determine the source of a conflict involving hardware (such as video cards) that requires specific I/O ranges for proper functioning. You'll find entries such as

```
x0070-x0073 System CMOS/real time
 clock
```

There's nothing you can do in order to change the I/O ranges used by CMOS or the system clock, but you can at least determine which devices are trying to share ranges. This is also reported in Conflicts/Sharing.

• *IRQs* reports on the great bugaboo of PC design. The IRQ (interrupt request line) has gained a fully justified reputation of being a bad idea, no matter how necessary it might have been all these years. A device sends an interrupt request to the CPU over these hardware lines, causing the processor to stop what it's doing and jump to a routine that handles the device's needs. If two devices that don't support sharing are attempting to use an IRQ, they can crash the system. PC systems have 16 IRQs available, several of which are necessarily used by the keyboard, the floppy and hard disk controllers, the printer port, and the communications port.

IRQs shows the IRQ assignments for all devices, as well as which IRQs are free, if any. This information lets you force a device to take a specific IRQ by changing its jumper settings or assigning the IRQ to that device

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via the Device Manager in Control Panel's System utility.

• *Memory* lists the assigned memory ranges for a system's hardware devices. Again, the purpose is to help determine conflicts and to help you see which memory ranges you can specify for a device by altering that device's properties using the Device Manager.

COMPONENTS

Msinfo collects information about your system's configuration and provides details about the status of your multimedia software, network devices, and drivers for the devices connected to your machine. The major section, *Components*, contains collapsible listings for multimedia devices and network devices and noncollapsible listings of a variety of other devices.

Each subsection in *Components* offers a choice among basic information, advanced information, and history—as long as the component in question has a device driver (almost all do). The advanced information will be of value primarily to system technicians, and the basic information will serve most users. The history, which reports changes in these components since their installation, can be useful for determining when a malfunctioning device in that category last worked properly.

• *Multimedia* contains three further subsections: *Audio Codecs*, *Video Codecs*, and *CD-ROM*. The main subsection lists an extensive range of data, including IRQ, DMA, I/O range, and driver details about your sound card and input devices for games and other multimedia software (most often joysticks). The information for each is presented in two columns, with the name of the resource type on the left and its value on the right.

The two *Codecs* areas list each codec—technology that takes compressed data from a hard disk (or across the network) and decompresses it on the fly as it is being used—in the system. *Video Codecs*, for example, might show MPEG or Cinepak devices and settings.

The *CD-ROM* area shows the drive letter for your CD-ROM, the volume name of the CD in the drive, the device identification (CDROM\0001, for example), and a description of the CD-ROM drive (such as TOSHIBA CD-ROM XM-1602B). This area also performs a data-transfer test from the CD-ROM and reports the name of the test file, its size, the transfer rate in kilobytes per second, and the percentage of CPU resources used by the transfer.

• *Problem Devices* identifies components that aren't working properly. The information is taken from the Device Manager. *Problem Devices* is helpful because it puts all the problem devices together in one place, which saves you time over looking through the Device Manager, where you'll also see all properly functioning devices. *Problem Devices* shows the name of each problem device along with its status.

• *History* keeps track of all component activity. You can ask for the complete history or only the past seven days; in either case the purpose is to determine when problems might have occurred. If you recall that problems began developing about four days ago, for example, you could call up the last seven days' component history to help you remember which devices were installed over that period of time.

• *System* tracks one of the most basic and most important sets of data about your system—details about the system BIOS, the motherboard, and other low-level components—so that you can report them to a technician as part of the troubleshooting process.

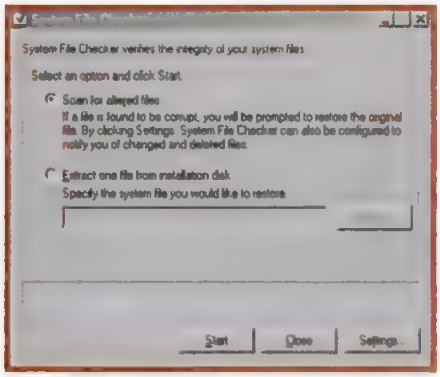

FIGURE 2: *System File Checker searches your system for corrupted and missing files and, if it finds any, offers to fix them by reinstalling them from the Windows CD-ROM.*

OTHER COMPONENTS SUBSECTIONS

The remainder of the subsections in the *Components* area of Msinfo are pretty much alike. *Display* provides details about your video cards and monitors (Windows 98 ships with multiple-monitor support), and *Infrared* shows driver and status details about any infrared devices you are using. The *Input* subsection displays name, driver, and status details for your keyboard and mouse, as *Modems* does for any modems you have connected. *Network* shows your network adapter information as well as details about installed protocols and network clients. A further subsection of *Network* offers information about the installed Winsock (Windows Sockets) version, unless you are using Winsock 2.0 or above. *Ports* provides details about serial and parallel ports. *Storage* summarizes the names and values for your disk drives. *Printing*, as you might expect, provides information about the installed printers, including the name of each printer, whether it is the default printer, details about fax systems that work with it, and available printer drivers.

SOFTWARE ENVIRONMENT

This section gives details about software loaded into memory. Whereas hardware problems often account for immediate crashes and obvious malfunctions, software interactions are frequently the most difficult to track and assess. The section is divided into seven subsections.

• *Drivers* has further subsections: *Kernel Drivers*, *MS-DOS Drivers*, and *User-Mode Drivers*. *Kernel Drivers* displays the protected-mode drivers loaded into memory (those commanding their own memory space). The information is displayed across eight columns. The Driver column shows the name of the kernel driver, with the Version column showing its version number. The name of the company producing the driver is shown in the Manufacturer column, and a brief explanation of the driver appears in the Description column. Next comes a column displaying the directory path of the driver, followed by a column showing where the driver was loaded from: the registry, the Plug and Play manager, the System.ini file, or elsewhere. The Type column tells you whether the driver is dynamic or static (whether the memory allocation is determined when the driver is run). The final column, Part of, shows what system the kernel driver belongs to.

A typical kernel driver entry displays information such as the following:

```
Driver: VCACHE
Version: None
Manufacturer: Microsoft Corporation
Description: Cache manager
Path: c:\windows\system\vmm32.vxd
Loaded from: Registry
Type: 4.1 Static
Part of: Microsoft Windows Operating
 System
```

User-Mode Drivers lists the ring 3 drivers in memory (ring 3 is the processor's privilege level for application-level software), such as the MIDI Mapper and the Sound Mapper, in much the same way as the kernel drivers (at ring 0). MS-DOS Drivers is much less elaborate, displaying only the name of the driver and its type. Himem.sys, for example, is shown with the name HIMEM and the type Device Driver.

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• *16-bit Modules Loaded* and *32-bit Modules Loaded* display details about the 16- or 32-bit programs, drivers, or DLLs (dynamic link libraries) in memory. The information given is similar to that in *Drivers*, including eight columns of data. This subsection gives date and memory information in place of *Drivers'* Loaded From and Type data. The details for the 32-bit display module for a notebook computer, for example, might look like this:

```
Name: SYNTPENH.EXE
Version: 4.1.16.26Feb97
Manufacturer: Synaptics, Inc.
Description: Synaptics TouchPad
 Enhancements
Path: c:\windows\system\syntpenh.exe
Date: 2/27/1997 12:50:05 AM GMT
Part of: Progressive Touch
Address: 00400000-00453000
```

• *Running Tasks* takes its information from Task Manager (which is accessible by pressing Ctrl-Alt-Del). The listing provides details about the executable files in memory, the version of each program, the program's manufacturer, a description, and so on, very similar to the display in *Drivers*. Unlike *Task Manager*, however, *Running Tasks* doesn't let you exit the programs; it just displays the information.

• *Startup Programs*, as the name suggests, provides details about programs Windows automatically starts when the operating system loads. This would seem to be nothing more than a repetition of the contents of the Startup folder, but more programs actually load at start-up than are shown in that folder. Microsoft Fast Find and Office Startup show up in both (as long as you have Microsoft Office), for instance, but SystemTray, ScanRegistry, TaskMonitor, and SchedulingAgent appear only in Msinfo. This subsection includes columns showing the name of the program, where it was loaded from (the registry, the Startup folder, or the Win.ini file), and the command line entry for starting the program.

• *OLE Registration* shows Windows file associations as recorded in the Win.ini file and the system registry, displaying these file associations in two further subsections, *INI File* and *Registry*. Both subsections list the data in the same manner, under six column headings. The Object column shows the file type in question, such as Word Document. A brief description of the object appears next, followed by the name and path of the program associated with that object type. Next come the version of the object, the version date, and the object size.

OTHER FEATURES OF MSINFO

As we mentioned earlier, Msinfo is not an interactive utility. It is meant solely for viewing a range of information about your system. That information is extremely important, however, and backing it up is highly recommended. The reason for backing up is simple: Msinfo tells you a great deal, but only if you can run Windows in the first place. Even resorting to safe mode isn't the answer, because in safe mode, Msinfo won't display hardware information, just component and software environment details. Obviously, without hardware information, especially details about possible conflicts, troubleshooting becomes much less precise.

You can save your system details as either a Msinfo file (.nfo) or a text file. The former is available through the *File | Save* command, the latter through *File | Export*. You can also print your system information—a good idea—but bear in mind that printouts of fully loaded systems running multiple programs can be dozens of pages in length.

Msinfo also features several useful utilities on its *Tools* menu. While they don't change Msinfo from a viewer to an interactive diagnostic and repair utility, their easy accessibility from within Msinfo makes it seem as though they do. Descriptions of them follow.

• *Update Wizard Uninstall* lets you uninstall updates to Windows 98 and return to the previous versions. Windows 98 patches and drivers are posted on Microsoft's Web site and are accessible through the Update Wizard, which installs the updates and stores the replaced older versions in a backup folder. Update Wizard Uninstall returns the older version to the system and places the newer version in the backup folder.

• Files that have been given a Microsoft digital signature, thereby verifying that they have been unchanged from the original, are called *signed files*. The *Signature Verification Tool* lets you search for signed or unsigned files on your system and also displays the signed files' certificates.

• The *Windows Report Tool* lets you send a report on your system to a technician, to help with repairs. The first screen of this wizard provides boxes for describing your problem and the results you hope to see, as well as the steps the technician should take to reproduce the crash or malfunction. The utility gathers your system information from Msinfo and saves it as a file to send to the technician. You can store the file on a floppy disk, or if you can get an Internet connection, you can send the file to your technician. In case you can't get into Windows, a DOS version of this tool, Dosrep.exe, is available on the Windows 98 Emergency Startup Disk.

Your operating system is only as good as the integrity of its files, and a corrupted system file can be bad news. *System File Checker* (see Figure 2) searches your system for corrupted files and, if it finds any, offers to fix them by reinstalling them from the Windows CD-ROM. It does the same with missing files. The utility can find corrupted files because Windows 98 writes a checksum for each file as it's written to the disk, and this checksum can be read to determine the file's integrity.

• *Registry Checker* runs whenever Windows 98 starts, examining the system registry for errors. If it finds any, Registry Checker loads the backup copy of the registry (created during shutdown) in its place. You can run Registry Checker manually from Msinfo as well.

• *Automatic Skip Driver Agent (ASD)* does what its name suggests—automatically skips loading problematic drivers. If a driver fails at system start-up, ASD flags it for observation. The third time it fails, ASD stops it from loading altogether. You can see what ASD has flagged by calling the utility from the *Tools* menu of Msinfo.

• The good *Dr. Watson* is no stranger to Windows users. It collects details about software faults, identifying them in a log file for future analysis. The file includes the name of the program causing a fault and the memory address in which the program was running at the time. The log file is available through the Msinfo Tools file.

• The *System Configuration Utility* replaces the Sysinfo utility in earlier versions of Windows, and it's much more useful than Sysinfo. There's no room to examine it in detail here, but essentially the utility lets you tell Windows how to start (including a diagnostic start-up) and lets you add or exclude elements in your Config.sys, Autoexec.bat, System.ini, and Win.ini files and your Startup folder.

Windows 98's Msinfo is rich with data and associated features. It gives you the degree of information you need to keep your system running properly, and just as important, it helps you provide information to people who know more than you about the technologies that underlie the OS. The utility could be more interactive in certain areas by tying itself in more tightly with the utilities in its *Tools* menu, but as it stands it's practically indispensable—except, of course, in the unlikely event that your system works without a hitch every single time.

Neil Randall is the author of The Soul of the Internet *(ITCP) and* Special Edition Using Microsoft FrontPage98 *(Que)*.

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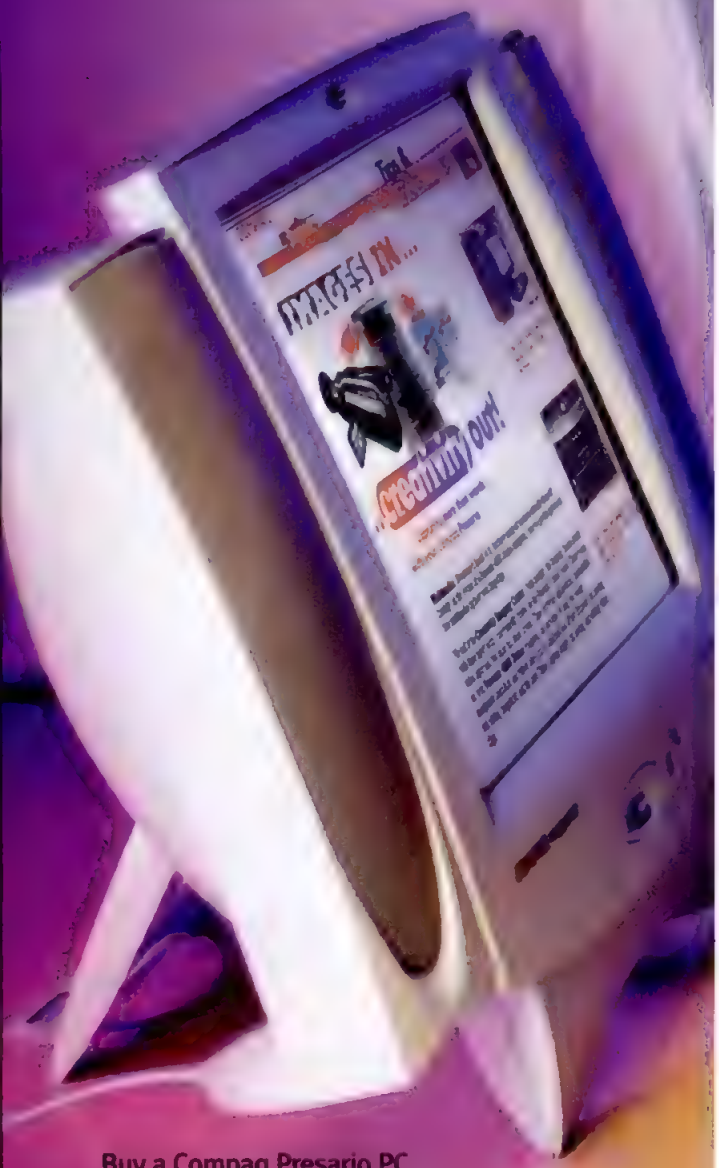

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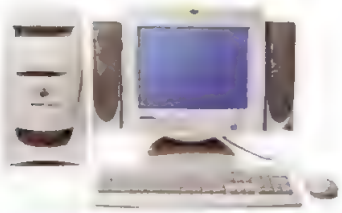

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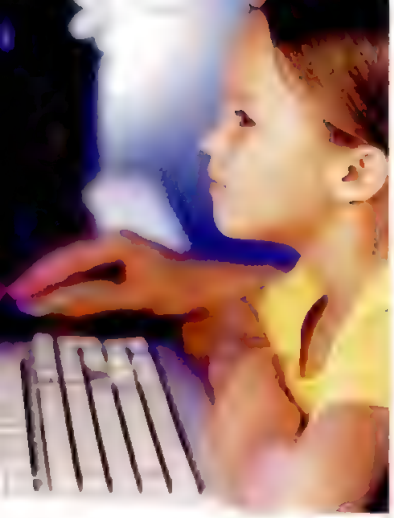

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Organize Downloads with HandsDown

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By Steven E. Sipe

If you've spent much time downloading files from the Internet, you know how tedious the task can be. This issue's utility, HandsDown, lets you use the Windows Clipboard to create a list of files for download from FTP or Web servers. You can then download the files all at once, when it's convenient, and save the list as a project file for reuse at a later time. A command line option lets you schedule downloads using Task Scheduler in Windows 98 or System Agent, which is available with the Windows 95 Plus! Pack.

HandsDown requires Windows 95, Windows 98, or Windows NT 4.0 or later. It also requires the Windows WinInet communication routines. These come with Win 95b (OSR2), Windows 98, and Windows NT. If you are running the original release of Windows 95, you can obtain WinInet by installing Microsoft Internet Explorer 3.0 or later.

You can obtain HandsDown free by download from PC Magazine Online or by mail. Refer to the sidebar "How to Get the Files" for details. The source code for HandsDown, which was written in C++ with the Microsoft Foundation Classes (MFC), is also provided for those interested in seeing how it works.

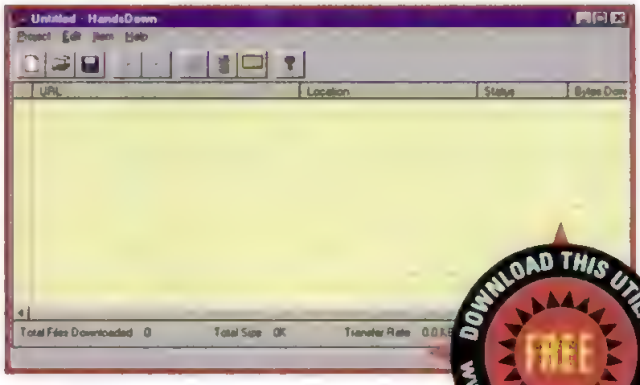

FIGURE 1: *When you first run HandsDown, its main screen appears with an empty download list and progress display.*

USING HANDSDOWN

To install HandsDown, copy its three program files (Hdown.exe, Hdown.cnt, and Hdown.hlp) to a subdirectory on your hard disk. When you launch HandsDown, the main window appears (see Figure 1). The main window contains a file list with a progress area below it. You can add, remove, and configure entries in the file list as described below. During a download, the progress area displays the number of files downloaded (*Total Files Downloaded*), the total size of all files downloaded (*Total Size*), and the transfer rate in kilobytes per second (*KBytes/Sec*).

PROJECT OPTIONS

HandsDown saves lists of files to download in project files. To create a new project, select *New* from the *Project* menu. To load an existing project, select *Open* from the *Project* menu. Once you have an active project loaded, you can configure its options by selecting *Options* from the *Project* menu.

The *Project Options* dialog (see Figure 2) lets you specify various characteristics for the current project. The *Number of Parallel Downloads* field determines the number of files that HandsDown can download simultaneously. For example, if you have this number set to *two* and there are at least two files in your download list, then HandsDown will download two files at the same time. You may need to adjust this number for optimal performance. If you have a slow connection, setting this number too high may slow down file transfers. Also, some servers don't support more than one connection at a time.

The *Number of Retries* option lets you specify the number of times that HandsDown will retry a failed download. HandsDown will attempt to download all the files in the project list before it goes back and begins to retry downloads.

When you select the option *Watch Clipboard for URLs*, HandsDown will examine the clipboard each time the contents change to determine whether the copied data is a URL that begins with *ftp://* or *http://*. If so, the utility checks to see whether the URL is already in the list. If the URL is a new one, HandsDown adds it to the download list. The *Default Directory* field lets you specify the default directory for new URL entries that are pasted from the clipboard.

The option *Don't Use Cached Files* tells HandsDown whether it should check for a file in its local cache before attempting to download the file from the server. In most cases, leaving this option unchecked (the default setting) results in optimal performance, allowing HandsDown to download only files that have changed since their last downloads. You will need to check this option only if you want to download a new version of a file and the old version still exists in the cache. Otherwise, if you're using cached files, WinInet will think that it already has the file and will ignore the new version.

Note that WinInet's resume feature for aborted downloads relies on the cached version of a file. If you want the ability to resume an aborted download, you must leave *Don't Use Cached Files* unchecked.

THE DOWNLOAD LIST

The next step is to add files to the download list. There are several ways to do this. To type

For Programmers Only HandsDown is a 32-bit Windows program written in C++ with Microsoft Foundation Classes (MFC). It can be compiled with Microsoft Visual C++ 5.0. The full source code for HandsDown is available from PC Magazine Online (www.pcmag.com) and demonstrates several interesting programming techniques, including how to

- monitor the clipboard to detect changes;
- create an FTP client using WinInet routines;
- use SHBrowseForFolder()to select folders.

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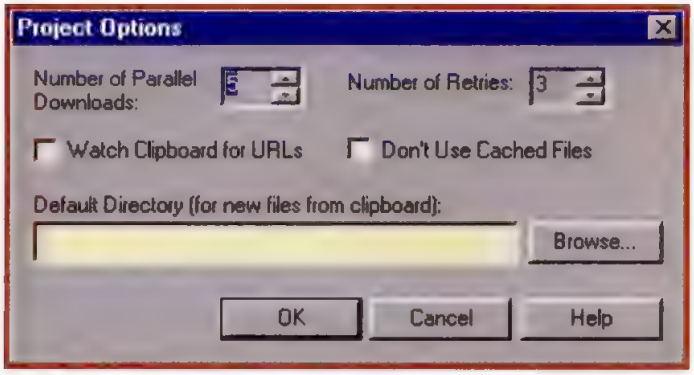

FIGURE 2: *HandsDown's Project Options dialog lets you set options that affect every file downloaded.*

in a URL, either select *Add to List* from the *Item* menu, click the *Add* button on the toolbar, or simply press the Insert key. Any of these methods will bring up the *Add New Item* dialog (see Figure 3).

The *Add New Item* dialog's *URL* field is where you specify a file's location on an FTP or Web server. The URL must begin with *ftp://* for FTP transfers or *http://* for HTTP transfers. The *Local File Location* field is where you enter the full path (directory and filename) of the downloaded file. The *Text Mode Transfer* option is necessary only when you're downloading text files from Unix-based machines. For most downloads, you should leave this option unchecked. When checked, the option causes HandsDown to translate any carriage returns it encounters in the download stream into combinations of carriage returns and line feeds, so Unix-based text files will be displayed properly on your PC. Do not choose this option when downloading a binary file such as a ZIP or DOC or the file will be corrupted.

The *User Name* and *Password* fields let you enter a user name and password to use when logging on to a server. If you leave these fields blank for an FTP transfer, they will default to *anonymous* for the user name and to your e-mail address for the password. If you leave these fields blank for an HTTP transfer, no user name or password will be used.

You can also add items to the download list by copying them from your browser. When viewing a Web page with a link to a file that you wish to download, right-click on the link and choose *Copy shortcut* from the context menu. If HandsDown is configured to watch the Clipboard, it will automatically add this new URL to the download list. If not, use the *Paste* item on the *Edit* menu to add the new URL to the download list manually.

If you want to change an item's properties, choose *Properties* from the *Item* menu or double-click on the item in the list. This will bring up the same dialog that you see when adding a new item.

When you add an item to the list, the check box to the left of the item is checked by default. This means that the file is selected for download. To prevent an item from being downloaded without removing it from the list, simply uncheck this box. To remove an item from the download list, select the item and choose *Delete* from the *Item* menu or click the *Delete* button on the toolbar.

To move an item to a different position in the download list, you can select the item and drag it to the new location. The item will be moved to the spot above the drop location. To move an item to the top of the list, drag it to a location just above the first item. The cursor appears as a rectangle when you're over a valid drop area and changes to a circle with a slash through it when you're over an invalid drop area.

When your project is set up the way you want, choose *Save* from the *Project* menu. It's a good idea to do this before you start downloading files.

DOWNLOADING FILES

To start the download process, select *Start Download* from the *Project* menu or click the *Start Download* button on the toolbar. The *Status* column in the download list tells you what's happening with each file in the list. If an item is not selected for download, the status field says *Skipped*. If a file is selected for download, its initial status is *Waiting*. This means that the item is scheduled for downloading but the download hasn't begun yet. Once the file begins to download, the status field changes to *In Progress*.

If an item is successfully downloaded, its status changes to *Done*. If the transfer fails for some reason, the status field says, *Retrying*. HandsDown will retry the download up to the maximum number of retries specified in the *Project Options* dialog. If it can't download the file after the maximum number of attempts, it displays the status *Failed*.

The *Bytes Downloaded* column in the download list indicates the number of bytes that have been downloaded for a particular item. This counter updates every second while an item is downloading, and it displays the final file size when the download is done. The bytes downloaded are displayed only during a download session. If you close the project and open it again, the number will be reset to 0.

To abort the downloading process, select *Stop Download* from the *Project* menu or click the *Stop Download* button on the toolbar. HandsDown will display a message window to acknowledge the stop request. Stopping may take a minute or so to complete, because HandsDown must properly shut down communications with the various servers to which it is connected. Items being downloaded when you abort the download will show the status *Aborted*.

COMMAND LINE MODE

HandsDown includes a command line interface so that you can use it in conjunction with scheduling utilities, such as the Windows 98 Task Scheduler or System Agent, which is included in the Windows 95 Plus! Pack. This lets you perform unattended downloads at specified times. To start HandsDown in command line mode, use the following syntax:

```
hdown myproj.hdn /a
```

where `myproj.hdn` is the name of the existing project that you want to use. The /a parameter tells HandsDown to run on automatic, without user intervention.

When running on automatic, HandsDown displays its main window, loads the specified project, and immediately begins to download files. When all the files in the download list have been processed, HandsDown exits

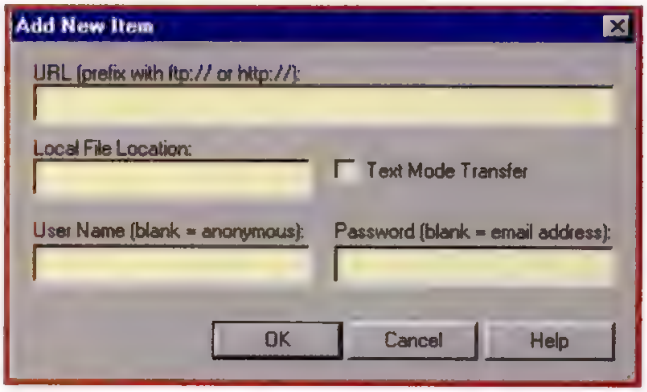

FIGURE 3: *The Item Properties dialog lets you specify options that affect a particular file.*

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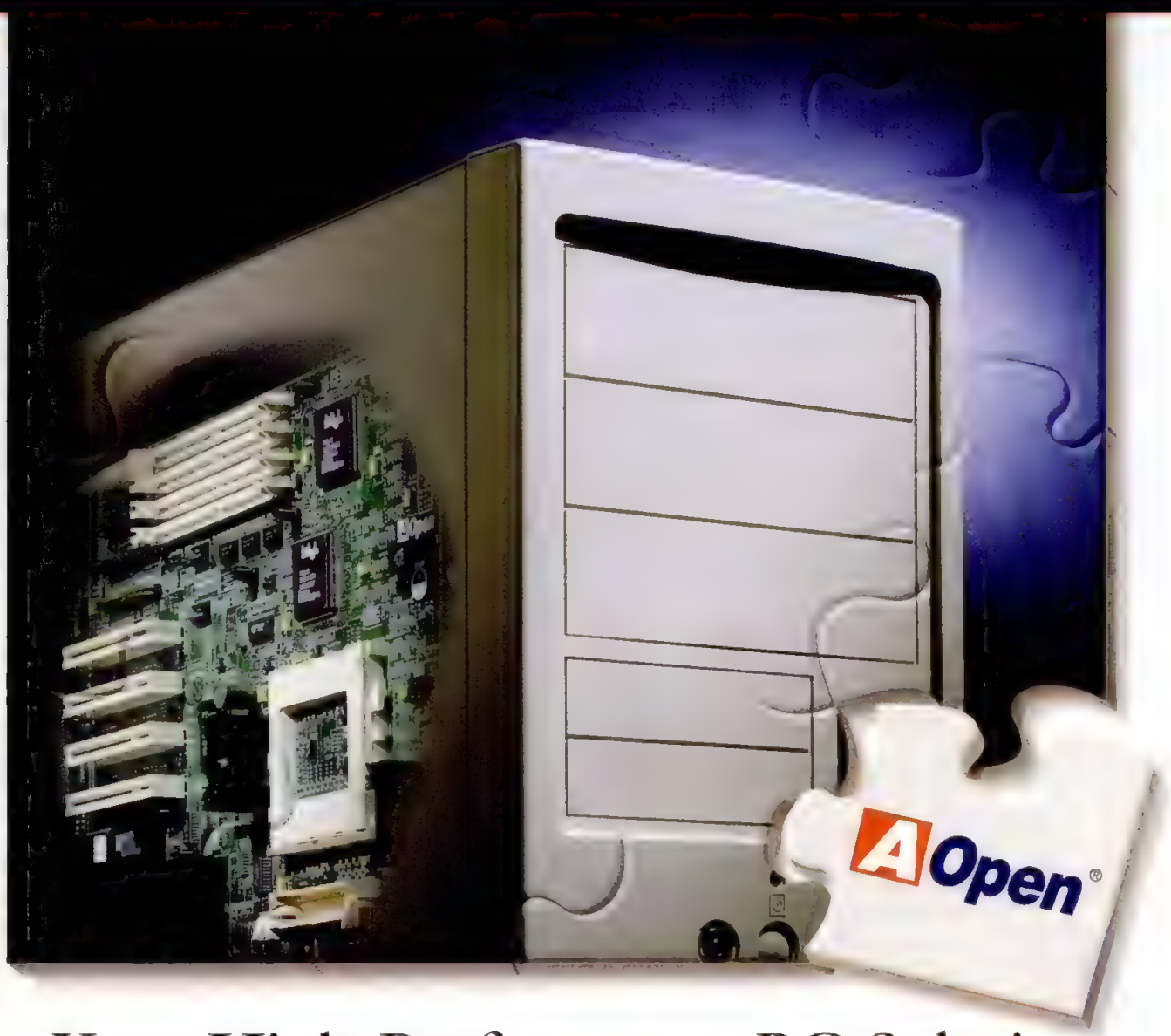

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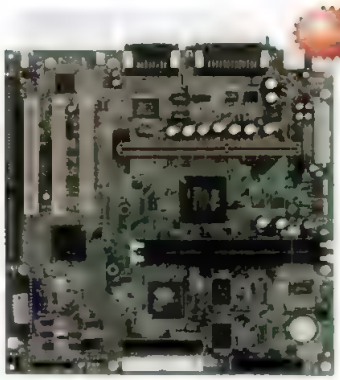

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automatically. To cancel automatic mode and stop the download, click the *Stop Download* button. This terminates the download process at its current point and prevents HandsDown from automatically shutting down.

If you connect to the Internet with a dial-up connection, you'll want HandsDown to connect and disconnect automatically as needed. HandsDown's WinInet routines handle automatic connection by telling Windows to establish a dial-up session. In the original releases of Windows 95 and Windows NT 4, this triggers a confirmation dialog requiring user intervention. However, this confirmation box is an option in the latest version of Dial-Up Networking, which ships with Win 95b (OSR2) and Win 98. To turn off the confirmation box, open My Computer, select *Dial-Up Networking*, and choose *Settings* from the *Connection* menu. In the dialog that appears, uncheck the box labeled *Prompt for information before dialing*.

Disconnection after downloading is an easier problem, because Windows handles it smoothly. Launch the Internet applet in the Control Panel and select the *Connection* tab. Depending on the version of Windows you're running, either you'll see the check box *Disconnect if idle for* xx *minutes* right on this page, or you'll be able to access it by bringing up the *Dial-Up Settings* dialog. Check this box and then fill in the number of minutes you'd like Windows to wait before disconnecting.

INSIDE HANDSDOWN

HandsDown is a 32-bit Windows application written in C++ with MFC. It can be compiled with Microsoft Visual C++ 5.0. The source code for HandsDown shows several interesting programming techniques, including how to monitor the Clipboard to detect changes, how to use the WinInet FTP routines, and how to use the Windows 95 and Windows NT 4 shell to select directories.

When you select *Watch Clipboard for URLs* in the *Project Options* dialog, HandsDown monitors the clipboard for valid URLs (text that begins with either *ftp://* or *http://*). It doesn't need to examine the Clipboard periodical-

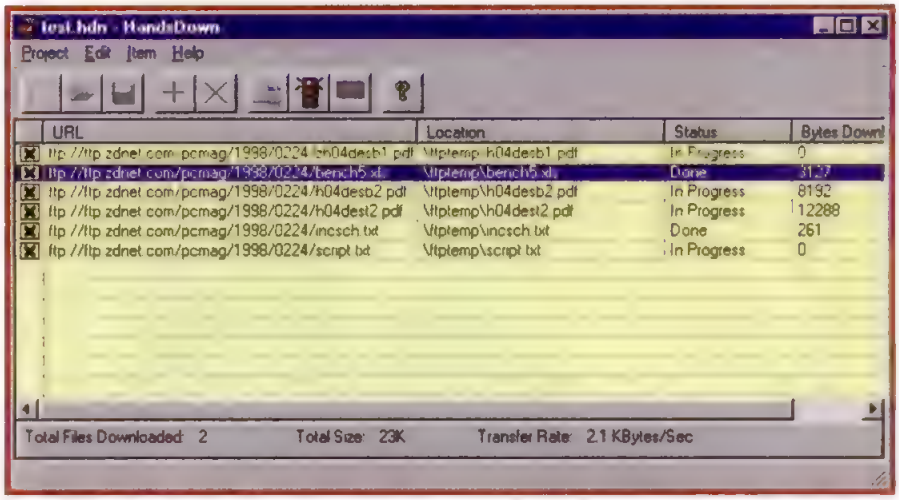

FIGURE 4: *HandsDown displays various messages to indicate the status of each file it is downloading.*

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ly to do this, because Windows can notify an application when new data is copied to the Clipboard. Windows does this by sending WM_DRAWCLIPBOARD messages to the Clipboard notification chain. To receive these messages, an application must register with Windows to become part of the chain. HandsDown does this by calling MFC's CWnd::SetClipboardViewer() method.

HandsDown's CHDView::OnDrawClipboard() method is a handler for the WM_DRAWCLIPBOARD message. When HandsDown receives this notification, the handler queries the Clipboard to see whether the new data is in text (CF_TEXT) format. If so, HandsDown retrieves the new text and determines whether it represents a valid URL. If it is, HandsDown searches the download list to see if the list already contains this URL. If the URL is not there already, HandsDown adds it to the list.

When HandsDown no longer wishes to receive Clipboard notifications, the utility must tell Windows to remove it from the Clipboard notification chain. It's very important for an application to do this before exiting. Otherwise, the notification chain will be broken and none of the other applications in the chain will receive notification messages.

HandsDown calls MFC's CWnd::ChangeClipboardChain() method to remove itself from the notification chain. There are two places in the HandsDown code where it calls this method to stop receiving notifications. The first call is made when the user disables the project option of watching the Clipboard for URLs. The second occurs when HandsDown's main window receives a WM_DESTROY message that indicates that HandsDown is exiting.

USING WININET

The WinInet routines let you create HTTP or FTP clients with only a few dozen lines of code. Without WinInet, you'd have to write hundreds of lines of WinSock code in order to handle TCP/IP communications. The WinInet DLL is actually the communications component of Microsoft Internet Explorer. Support for WinInet is built into Windows 95b (OSR2), Windows 98, and Windows NT 4.0. To add WinInet to the original version of Windows 95, you must install Internet Explorer 3.0 or later.

To establish a new WinInet session, start by calling InternetOpen(). This initializes the WinInet DLL and establishes a connection between your application and Internet Explorer. Next, call the InternetConnect() routine to establish a session with a particular FTP server. InternetConnect() supplies a user ID and password to the FTP server and performs the log-on process.

> The modern Windows shell includes the powerful function SHBrowseForFolder(), which is designed for letting the user choose a directory.

Once you've established a session with the server, call the FtpOpenFile() routine to open a particular file on an FTP server. If the file is opened successfully, subsequent calls to InternetReadFile() will let you download its contents. When you've finished reading data from the file, call InternetCloseHandle() to tell it to close the file on the FTP server. To end the WinInet session, call InternetCloseHandle(). This closes your connection to Internet Explorer and releases any extra memory that WinInet has used on behalf of your application.

SELECTING FOLDERS

HandsDown lets the user select a default download directory for files that are pasted into the file-download list. The common Windows dialogs for opening and saving files, wrapped by the MFC class CFileDialog, are no help when you need to select a directory. In earlier versions of Windows, I would have had to create a directory-selection dialog from scratch or perform major surgery on one of the common dialogs. However, the modern Windows shell used by Windows 95 and Windows NT 4 includes the powerful function SHBrowseForFolder(), which is designed specifically for the task of letting the user choose a directory.

SHBrowseForFolder() takes as its only parameter a BrowseInfo structure that, among other things, defines what types of folders should be displayed and where the folder tree should be rooted. HandsDown needs a tree that displays only file-system folders, so it sets the ulFlags member of the BrowseInfo structure to BIF_RETURNFSANCESTORS|BIF_RETURNONLYFSDIRS. The tree should show all possible download locations, including nonmapped network drives. To achieve this, HandsDown simply passes NULL as the BrowseInfo structure's pIdlRoot member. The value returned by SHBrowseForFolder() is a PITEMIDLIST rather than a text string, but a call to SHGetPathFromIDList() converts it to a more useful form. Finally, before exiting, HandsDown must free the memory allocated for the PITEMIDLIST using the shell's own pMalloc object. Keep SHBrowseForFolder in mind anytime your program needs to prompt for a folder.

THUMBS UP FOR HANDSDOWN

If you download files on a regular basis, you'll appreciate the convenience that HandsDown offers. You can set up and save lists of files to download, and the command line option lets you schedule downloads for a more convenient time.

Steven E. Sipe, the author of HandsDown, is a developer based in Wilmington, North Carolina. Sheryl Canter is the editor of the Utilities column and a contributing editor of PC Magazine.

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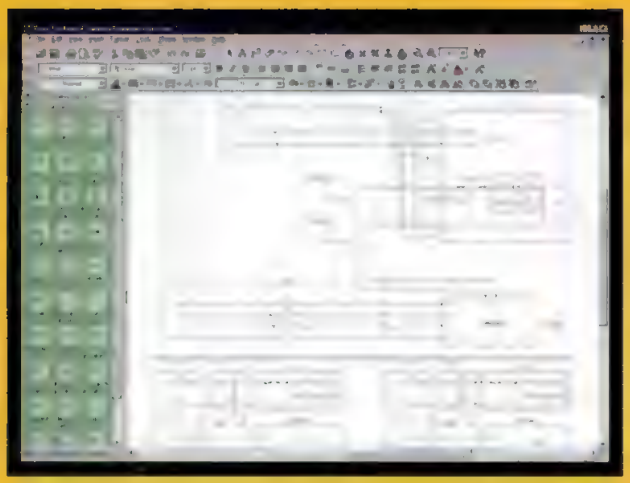

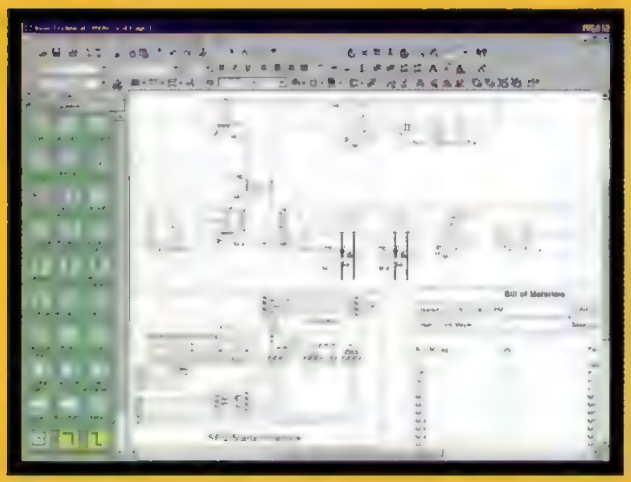

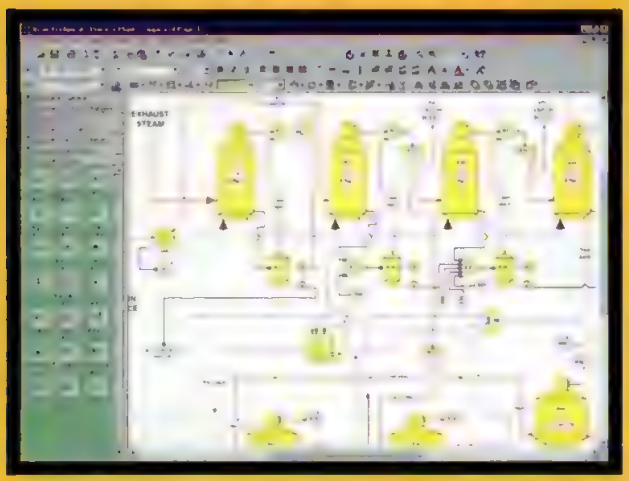

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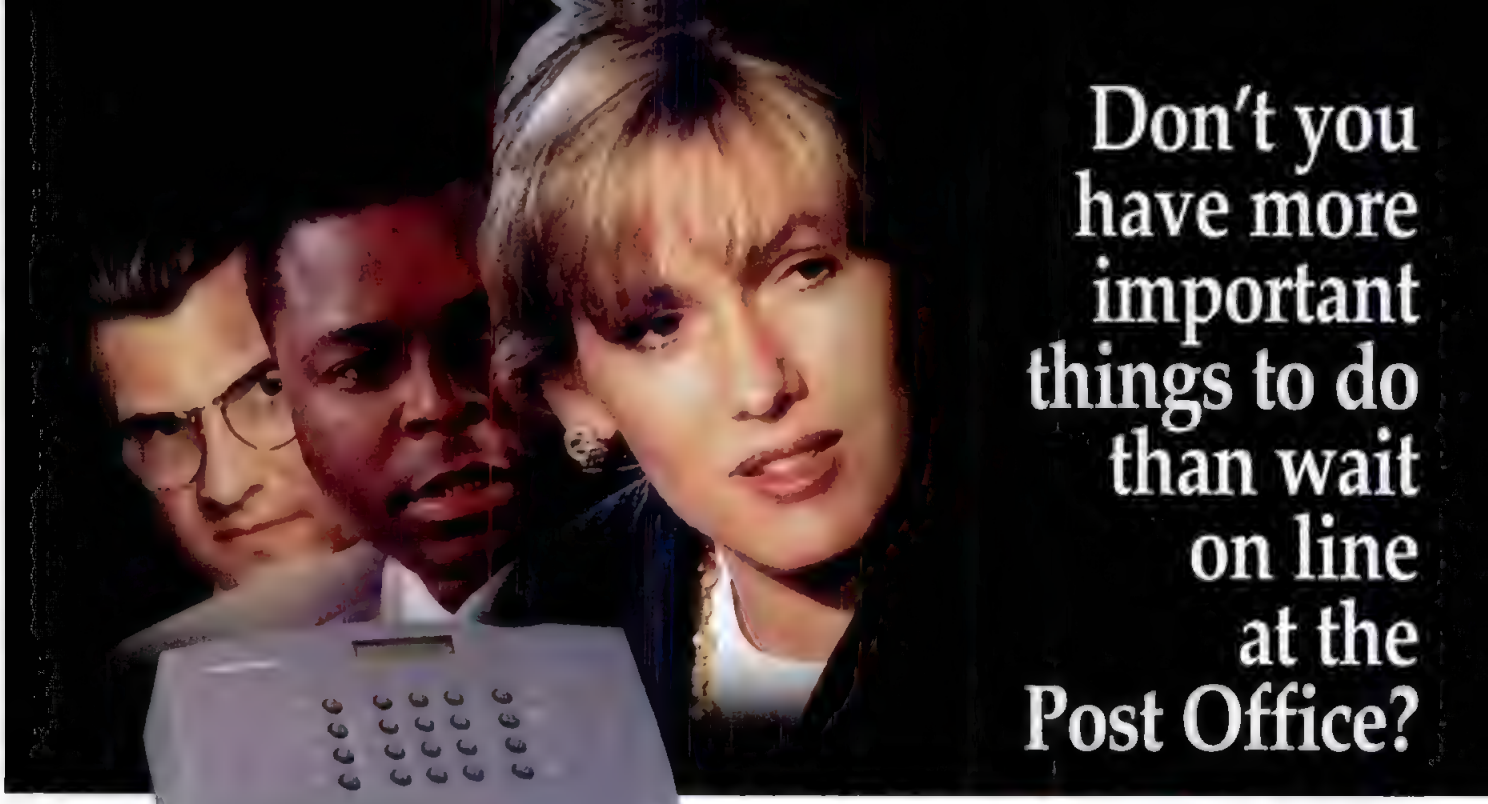

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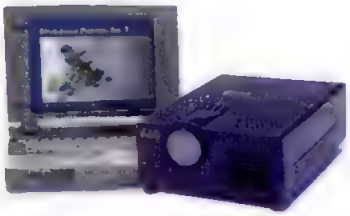

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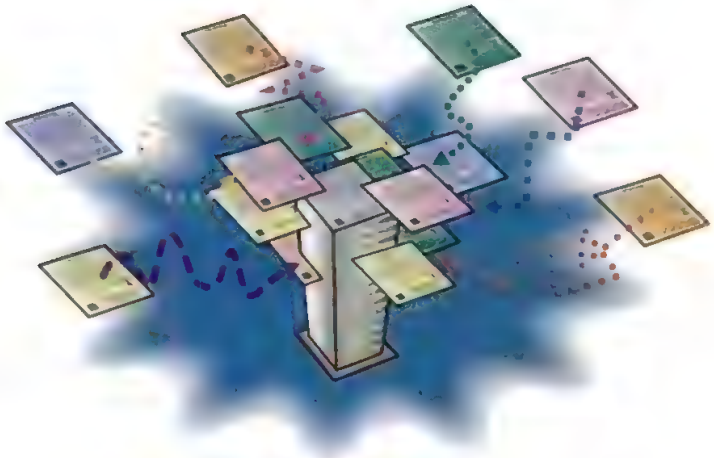

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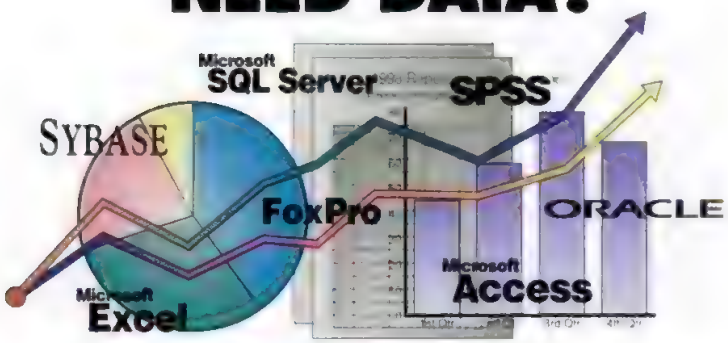

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User-to-User

BY NEIL J. RUBENKING

The Power of Scripts

PC MAGAZINE: Years ago, when dinosaurs roamed the earth and DOS ruled the desktop, most of the User-to-User tips submitted by readers involved batch files. We published batch files for all purposes—cataloging floppy disks, moving files, managing function-key menus, and hundreds more. Batch file programming doesn't require advanced training; with a little practice anybody can do it. Unfortunately, the batch file language isn't powerful enough to be truly useful under Windows, and in recent years, the flood of batch file submissions has diminished to a trickle.

With the advent of Windows 98, there's a new tool within reach of the average user—the Windows Scripting Host (WSH). You can write scripts in VBScript or JScript and run them under the WSH. Neither scripting language is as simple as the old batch language, but they're not overwhelmingly complex. If you ever used the old BASIC or QBASIC programs that came with DOS, VBScript will seem familiar. I'm looking forward to the first reader submissions based on VBScript or JScript!

Just to get the ball rolling, I've created a simple script that edits the user name and company name recorded in the system registry. This is necessary when a computer is sold or given away, or when a company computer is assigned to a new user. It's possible to correct the registered owner and company using RegEdit, but the VBScript file shown in Figure 1 does the job without invoking the dangerous power of RegEdit.

Many useful VBScript capabilities are wrapped in an object called `WSHShell`. These capabilities include reading and changing the registry, working with the environment, creating shortcut files, and launching other programs. The FixOwner script creates a `WSHShell` object, then makes two calls to a subroutine called `ChangeOne`.

`ChangeOne` takes two arguments, a registry value name and a name to display to the user. The routine reads the current data for the specified value using the `RegRead` method of the `WSHShell` object. Then it calls the VBScript function `InputBox` to prompt the user for a new value. If the user made a change and clicked OK, it writes the new value using `WSHShell`'s `RegWrite` method. Finally it uses the `Popup` method of `WSHShell` to report on the change it made or to report that no change was made. Note that an underscore at the end of a line signifies that the command is continued on the next line.

If you write a script that performs some generally useful task, be sure to submit it for possible publication in User-to-User. Batch files are nearly dead, but Windows scripts are very much alive!

```
' Windows Scripting Host Script to correct the
' registered owner and company name in the Registry

Dim WSHShell
Set WSHShell = WScript.CreateObject("WScript.Shell")

ChangeOne "RegisteredOwner", "Owner"
ChangeOne "RegisteredOrganization", "Company"

Sub ChangeOne (valName, dispName)
  ' Read the old value from the Registry
  oldValue = WSHShell.RegRead("HKLM\SOFTWARE\Microsoft\" +_
    "Windows\CurrentVersion\" + valName)
  ' Prompt the user to input a new value
  newValue = InputBox("Old Value " + Chr(34) + oldValue + _
    Chr(34), "Change Registered "+dispName, oldValue)
  ' Was any change requested?
  If (newValue <> "") AND (newValue <> oldValue) Then
    ' If so, make the change...
    WSHShell.RegWrite
    "HKLM\SOFTWARE\Microsoft\Windows\" +_
      "CurrentVersion\"+valName, newValue
    ' ... and report the change
    WSHShell.Popup "Registered " + dispName + " changed " +_
      "from " + Chr(34) + oldValue + Chr(34) + " to " +_
      Chr(34) + newValue + Chr(34)
  Else
    ' If not, report that no change was made
    WSHShell.Popup "No change to registered " + dispName
  End If
End Sub
```

FIGURE 1: *This simple Windows Scripting Host script lets you correct the user name and company name in the Windows 98 system registry.*

Don't Miss These Great Windows 98 Utilities

The Windows 98 beta-preview disk includes many utilities you may not know about. You install some by following the instructions in the Readme.doc found in the Tools\ResKit folder on the beta CD. Others are elsewhere on the CD, or they're on your disk already but don't have entries in the Start *menu.*

Scanreg.exe, found in C:\Windows\Command, scans the registry for errors and backs it up. Sfc.exe, in C:\Windows\System, scans the system files for errors and prompts you to restore any that have been corrupted. I've added both of these to my Task Scheduler.

Cfgback.exe, found on the Win 98 CD in Tools\ResKit\Registry, can make a number of backups of the registry. Eru.exe (on the CD in Tools\Misc\Eru) makes an emergency recovery disk with compression and decompression utilities, allowing you to back up your registry, INI files, Autoexec.bat, and Config.sys on a single floppy. Windiff.exe, installed with the Resource Kit, allows you to do file and directory comparisons with a number of filters, so it's a very powerful tool.

Another very useful set of files can be found on the CD in Tools\Oldmsdos. I copied these to C:\Windows\Command and made a shortcut for Help.com called Help Dos, which I placed in the C:\Windows\Start\Programs folder. Although some of the information is

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outdated, it is a very useful reference for creating batch files. QBASIC is also included here.

QuickTray (Quiktray.exe) is another handy utility installed with the Resource Kit. You can use QuickTray to put an icon for any program or shortcut in the taskbar's system tray. One good idea is to make a text file on your desktop called Notes.txt and add this to QuickTray. You now have a very useful instant note-taking utility. I have also added a number of other useful items. Now with a single click I can open my favorite programs.

JAMES HAMILTON
North Highlands, California

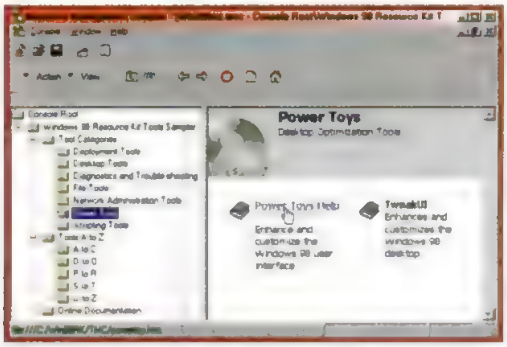

FIGURE 2: *The Windows 98 Resource Kit includes a set of utility programs, ranging from desktop enhancements to network administration tools.*

PC MAGAZINE: The majority of extra utilities associated with Windows 98 are contained in the Windows 98 Resource Kit (see Figure 2). Several have been described above, but there are a few more that deserve special mention. CheckLinks scans your *Start* menu and desktop, locating and removing shortcuts that point to nonexistent files. ClipTray stores chunks of boilerplate text and copies them into the clipboard at your request. And TweakUI, the most famous member of Microsoft's utility collection Power Toys, is now included in the Resource Kit.

You'll also find diagnostic tools, network administration tools, and several small utilities that enhance command scripts and batch files. WaitFor pauses execution until a specific signal is received over the network, with an optional time-out. WinSet sets or changes global environment variables. The utility Where reports the location of a specified file on the path or within a specified starting directory. And TimeThis executes a command and reports how long it took.

As of this writing, Windows 98 is still in beta testing, and the precise contents of the CD are changing from version to version. Some of the utilities mentioned here may be eliminated from the final CD or superseded by newer programs. To get the full benefit of upgrading to Windows 98, you absolutely must spend some time exploring the extra utilities supplied on the Windows 98 CD.

Windows 98's Gradient-Fill Title Bars

PC MAGAZINE: A number of sharp-eyed readers have written to ask about an unusual effect they've noticed in some of our recent screenshots. In the title bar of the window, the background color changes gradually from one color at the left edge to another color at the right, an effect called a *gradient fill.*

Enhancing your own system with this visual effect is quite simple. Right-click the desktop, choose *Properties,* and click the *Appearance* tab in the resulting dialog (Figure 3). Pull down the Item list and select *Active Title Bar.* You'll notice that the *Color 2* control (which was not present in Windows 95) is now enabled. By default, *Color* and *Color 2* have the same value, which results in a standard solid-color title bar. If you set a different value for *Color 2,* the title-bar background will become a gradient fill, with the value of the *Color* control on the left and that of the *Color 2* control on the right. Try various settings until you find one that pleases you. You may also need to change the font color to something that contrasts with both of the background colors. Now select *Inactive Title Bar* in the Item list and repeat the process.

Not surprisingly, Windows NT 5 also has the ability to define gradient-fill title bars. In fact, in Windows NT 5, the default color scheme uses a gradient fill for both active and inactive title bars.

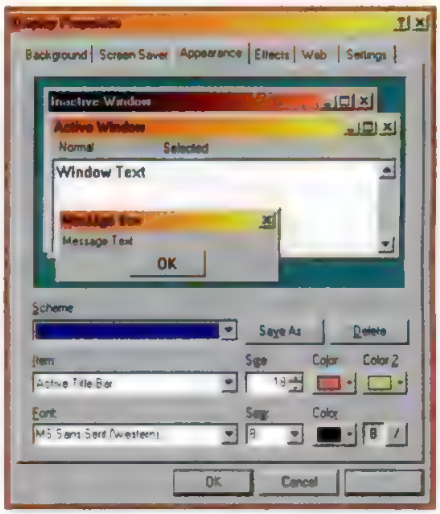

FIGURE 3: *In Windows 98 (and Windows NT 5), setting the* Color *and* Color 2 *controls to different values produces a gradient fill in the title bar's background.*

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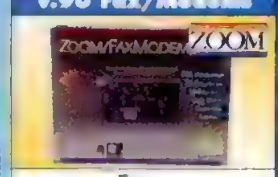

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HARDWARE

SCSI for CD-RW?

I have a Pentium/200 system with an IDE hard disk, a single 6X IDE CD-ROM, and a 4X-by-8X IDE CD-ROM changer. My system also has a SCSI scanner, using an ISA SCSI card that came with it. I'd like to add a CD-RW drive. Would it be wise (or possible) to replace my current CD-ROMs with an internal SCSI CD-ROM, then add an internal SCSI CD-RW and daisy-chain them with the external scanner? If so, should I get a SCSI-2, SCSI-W, or SCSI-UW interface? Would this setup facilitate copying CDs to CD-RW format?

DAVE LAMBERT
via the Internet

PC MAGAZINE: The last part of your question is the most critical; if you're planning to make copies of audio CDs on CD-RW disks, then you almost certainly want to go with a SCSI interface for your CD-ROM and CD-RW drives.

You can run into problems using an IDE CD-ROM drive as your source. In some cases, the CD-RW software may not recognize the IDE drive at all. If it does, the IDE interface often has difficulty maintaining an unbroken data stream to the recorder. The result is a copy with pops and distorted sounds that seriously degrade the sound quality. You're much better off with a SCSI interface for both drives.

The question of which interface to use is trickier, as the answer involves your needs, your future plans, and your budget. There is actually a matrix of SCSI choices to consider.

The first dimension is the basic data-transfer speed. The original SCSI specification had a theoretical maximum data-transfer rate of 5 MBps. Then came Fast SCSI, or SCSI-2, which is capable of up to 10-MBps transfer rates. Many devices are designed for the SCSI-2 specification. Newer devices use the Ultra SCSI specification, SCSI-3 (or Fast-20 SCSI), capable of up to 20-MBps transfer rates.

All these rates are based on the original 8-bit data path. Starting with SCSI-2, however, there has also been a Wide option, which uses a 16-bit data path, doubling the transmission rates. A Fast/Wide SCSI-2 connection has a theoretical maximum transfer rate of 20 MBps, and a Fast/Wide Ultra SCSI transfers up to 40 MBps.

Now, the faster and wider adapters cost more than the slower and 8-bit versions, and they may not be worth the extra cost. Water coming from a garden hose won't flow any faster if you send it through a 3-foot-wide pipe; similarly, there's no need to buy additional capacity in a SCSI controller if none of your devices can use the extra bandwidth. A 12X CD-ROM drive sends out data at only 1.8 MBps, so even a SCSI-1 interface can handle that load with ease. Chances are that your scanner may be able to produce data faster than that, however, so you'll want to make certain that your new interface works at least as fast as the fastest device on your SCSI chain. Unless you're planning to add a device that can take advantage of a Fast/Wide SCSI interface, there is little reason to spend the extra money for that feature.

Also, keep in mind that even though you may have the technological tools to do something, you may not have the legal right to do it. If you are planning to make duplicates of copyrighted materials, you may want to check what you may and may not do within the law before you start.—*Alfred Poor*

OPERATING SYSTEMS

Changing the Windows 3.1 Start-Up Logo

I'd like to change my Windows 3.1 start-up logo. Can I replace the current logo with a bitmap of my own creation? Can I do this with Paintbrush or do I need a more sophisticated program?

MIKE PONTILLAS
via the Internet

PC MAGAZINE: Paintbrush won't work, because you need to create an RLE file (a run length encoded bitmap). The RLE variation on the bitmap file type is supported by Windows, but not many programs produce such files. Probably the best idea is to create a BMP file and then find a conversion program to make it into an RLE file. Then you need to go into your Windows System directory and find the file Vgalogo.rle. Rename this file something else, and replace it with your new RLE, which should not be much over 40K in size.

The easiest way to get the new logo incorporated is to use Setup to change something significant, like your video resolution. Change it and restart Windows and the new logo will appear. You can also incorporate the logo by combining three files using a DOS command while in the Windows System directory:

```
COPY /B WIN.CNF+VGALOGO.LGO+
VGALOGO.RLE WINX.COM
```

If WINX.COM is larger than 64K, your RLE file is too large; try again. Otherwise, move WINX.COM from the System directory to the Windows directory and run it. If it works, you can replace the old WIN.COM with WINX .COM. This is the same thing Setup does: Each time you make a serious change, it re-creates WIN.COM.—*Neil J. Rubenking*

WORD PROCESSING

Entering Day and Date in Word 7 and Word 97

Is there any way Word 97 can check dates and report when you've entered the wrong day for a date? For example, if you write Sat., December 15, *when the 15th actually falls on a Tuesday, is there a way to have Word report the error?*

MARIE O'BRIEN
via the Internet

PC MAGAZINE: Word can do better than checking the day for you; it can insert the day, cour-

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tesy of the Quote field. Fields, in case you're not familiar with them, are codes you can enter in your document to let Word calculate a result. The definition of the Quote field is that it will insert whatever text you specify. Think of it as a literal quote. However, it's quite a bit more useful than the definition implies. You can, for example, enter a particular date in the field, define a format for that date, and let Word insert the date in the correct format. If you want to use 12/15/98 with a format that shows the day of the week, the month, and the day of the month, the field would take the form:

```
{quote "12/15/98" \@ "ddd, MMMM d"}
```

The curly braces to the left and right of the field are field markers, not text, and can't be entered as separate characters. The field itself consists of the field name, the date you want to insert enclosed in quotation marks, the date-time picture switch `\@`, and the format definition, also enclosed in quotation marks.

The `ddd` in the format definition indicates the day of the week in three letters; `MMMM` indicates the month fully spelled out; the `d` indicates the day. The code `dddd`, in contrast, would spell out the full name, `MMM` would give the three-letter abbreviation for the month, and `dd` would give two characters for the day in all cases, so the fourth of the month would be given as 04. For a full list of date format codes, choose *Help | Contents* and *Index* in Word 97 or *Help | Microsoft Word Help Topics* in Word 7. Then choose *Contents* and select *Reference Information*, then *Field Types and Switches*, then *Date-Time Picture (\@) field switch*.

There are several ways to enter a field. You can hit Ctrl-F9 to enter the field markers, and then type the text for the field. When you're done, hit F9 to update the field and see the field result. If it doesn't show after you hit F9, use Alt-F9 to toggle Word between showing field codes and showing field results.

In this particular case, you might want to use a macro to do most of the typing, since you may want to use this field repeatedly, with different dates, of course. The macro itself will be radically different depending on whether you're using VBA (Word 97's macro language) or WordBasic (Word 7's macro language), so I won't show it here. However, the procedure for recording it is essentially identical in both versions of the program.

To record the macro, start by making sure Word is set to show field results: Choose *Tools | Options* and *View*, and make sure the *Field Codes* check box isn't checked. Next, enter a date in month/day/year format (such as 12/15/98), and leave the cursor immediately after the year. Only then should you start recording.

In Word 97, choose *Tools | Macro | Record New Macro*, enter an appropriate name, and choose *OK*. Next, hold the Ctrl and Shift keys down and hit the Left Arrow key five times to select the date. Then choose *Edit | Cut* to cut the date from the document and put it in the clipboard. Hit Ctrl-F9 to insert the field markers, and enter the text for the quote field—either as shown above or with the date format modified as needed. Rather than entering the date from the keyboard, however, choose *Edit | Paste*.

After you finish entering the text for the date, hit F9 to update the field, use Ctrl-<Right Arrow> to move beyond the field, and add a space after the date. Then stop recording by choosing *Tools | Macro | Stop Recording* or clicking on the *Stop Recording* button.

For Word 7, there's one minor variation in these steps and one complication. To start recording in Word 7, choose *Tools | Macro*, enter an appropriate name, and choose *Record*, then *OK*. If you're in Normal view, you can then record the macro using the same steps as for Word 97. The complication you may run into in Word 7 is that if you're in Page Layout view when you hit Ctrl-F9, Word will toggle to show field codes. If you normally work in Page Layout view, you'll want to toggle back to show field results as part of the macro before using Ctrl-<Right Arrow> to move beyond the field. These same steps should work for Word 6 also, since it's nearly identical to Word 7.

Whatever version of Word you're using, if you followed these steps, you should now be able to enter the day and date at any time by typing the date in month/day/year format and running the macro. For maximum convenience, attach the macro to a keystroke combination, toolbar button, or menu item, so that you can simply type the date and then run the macro in one or two keystrokes or mouse clicks.—*M. David Stone*

DATABASES

Changing Access's Most Recently Used Files List

When I start Microsoft Access 97, an inaccurate list of filenames pops up as possible files to open. What's irritating about the list is that the program remembers these filenames even after the files have been moved or deleted. For example, the list includes a file that was once opened on the A: drive, among others that are long gone. How can I edit the file list and erase the historical memory to see just the one real file that resides on the hard disk?

ED CHEPAN
via the Internet

PC MAGAZINE: Access 97 stores the most recently used files list (MRU) in the system registry. The values are named MRU1, MRU2, MRU3, and MRU4, and they are found under the key

```
HKEY_CURRENT_USER\Software\Microsoft
\Office\8.0\Access\Settings
```

For each MRU value, there is also an undocumented but corresponding value named `MRUFlagsn`, which stores bitmapped information about the corresponding file.

You can manipulate these values programmatically by calling the Win32 API functions devoted to registry access, which isn't difficult with VBA. The problem is that if you modify or delete these values while Access is run-

```
[version]
signature="$CHICAGO$"

[DefaultInstall]
AddReg=AddMe

[AddMe]
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRU1",4,
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRU2",4,
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRU3",4,
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRU4",4,
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRUFlags1",4,
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRUFlags2",4,
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRUFlags3",4,
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRUFlags4",4,
```

FIGURE 1: *Installing this INF file will clear Access 97's most recently used files list.*

```
[version]
signature="$CHICAGO$"

[DefaultInstall]
AddReg=AddMe

[AddMe]

HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRU1",0,"C:\Northwind.mdb"
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRU2",0,"C:\Orders.mdb"
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRU3",0,"C:\Solutions.mdb"
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRU4",0,"C:\MyDatabase.mdb
"
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRUFlags1",65537,0,0,0,0
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRUFlags2",65537,0,0,0,0
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRUFlags3",65537,0,0,0,0
HKCU,"Software\Microsoft\Office\8.0\Access\Settings","MRUFlags4",65537,0,0,0,0
```

FIGURE 2: *You can explicitly set the Access MRU list by installing this INF file prior to running Access. Be sure to edit the lines as needed with the locations of your own database files.*

ning, your efforts will be thwarted by the way Access loads and saves the MRU list. When Access starts, it loads the list by reading the values stored in the registry. When Access quits, it writes the current list to the registry. Any changes you make in the meantime are overwritten.

PC Magazine's contributing technical editor, Neil Rubenking, suggested what is probably the easiest way to clear the MRU list. Figure 1 shows Cleanmru.inf, a Windows device information file (INF file) that can be used to clear the list. To use it, highlight the file in Explorer, then right-click and choose *Install*.

Once you have the list cleared, the easiest way to get the right files back into the list is to open them with Access. If, however, you want to set the list explicitly prior to running Access, you can do so with the file Setmru.inf, shown in Figure 2. This file updates the MRU list with the database names shown. You'll need to change the database names to suit your needs. When you do, be sure to enter fully specified file locations. As with Cleanmru.inf above, you highlight the file in Explorer, then right-click and choose *Install*.

If you always want to run the Setmru.inf installation prior to running Access, you can do so by placing these commands into a batch file:

```
start /w /m rundll.exe
setupx.dll,InstallHinfSection
DefaultInstall 132 c:\setmru.inf

start "C:\Program Files\Microsoft
Office\Office\MSACCESS.EXE"
```

The first line runs Setmru.inf, and the second runs Access. Make sure the first line has the correct location for Setmru.inf and the second has the correct location for the Access executable file. If you choose this approach, you'll probably want to create a shortcut to the batch file and then select the shortcut's Close on Exit property. You can run the batch file by double-clicking the shortcut.

For more information on how to use INF files, see the Windows NT 4.0 DDK Programmer's Guide and Appendix C in the Windows 95 Resource Kit.

For more information on Rundll.exe, go to Microsoft's Web site at *www.microsoft.com/support* for Q164787.

For more information on the Start /W command, see the Windows 95 Resource Kit or type *Start /?* at the DOS command line.

Of course, if you're comfortable using RegEdit, the registry editor provided with Windows 95, you can use it to edit or remove the MRU values directly. The usual registry cautions apply: Back up your System.dat and User.dat registry files in advance and defer to an experienced system administrator if you're not experienced with RegEdit.

Cleanmru.inf, Setmru.inf, and RunAccess.bat can be downloaded from PC Magazine Online. Point your Web browser to *www.pcmag.com/download*, choose *PC Tech Issue Archives*, download the file V17n14.zip, unzip it, and look for the file Acmur.zip and unzip that.—*Sal Ricciardi*

SPREADSHEETS

Changing the Format of Complex Numbers in Excel

I am using the complex-number functions in Excel 95. After I do a few mathematical operations, there may be 14 decimal places in the real or imaginary part of the number. I have tried changing the number format with the Format | Cells | Numbers *command, but that has no effect. Is there a way to change the format of complex numbers?*

CLAY JOHNSTUN
Chandler, Arizona

PC MAGAZINE: *Format | Cells | Numbers* doesn't work because Excel uses text strings to represent complex numbers. Thus, where `a + bi` may be a number to you, to Excel it's nothing more than a particular type of text.

If you take a "simple" complex number such as `3 + 4i` and use that as an argument for one of Excel's complex-number functions, such as `IMCOS` (which returns the cosine of a complex number), you may get something with more precision than you bargained for, such as:

```
-2294052430.5531-5012596009.170511
```

Unfortunately, the complex-number functions don't include arguments that let you specify the amount of precision you want, so you always get maximum precision. The only way to round the real or imaginary component of a complex number is to go in and manipulate the text. If the text is the calculated result of a function, you'll need to convert it to a constant first. You can do that by selecting the cell in question, pressing F2, and then pressing F9. Or, to convert a range of cells to constants, select the range, choose *Edit | Copy*, then choose *Edit | Paste Special*. In the *Paste Special* dialog box, choose the *Values* option and click *OK*. Once you've converted the number to a constant, you can edit the text to the desired precision. Note that after editing the text of a complex number, you can still feed that result into another complex-number function.—*Craig Stinson*

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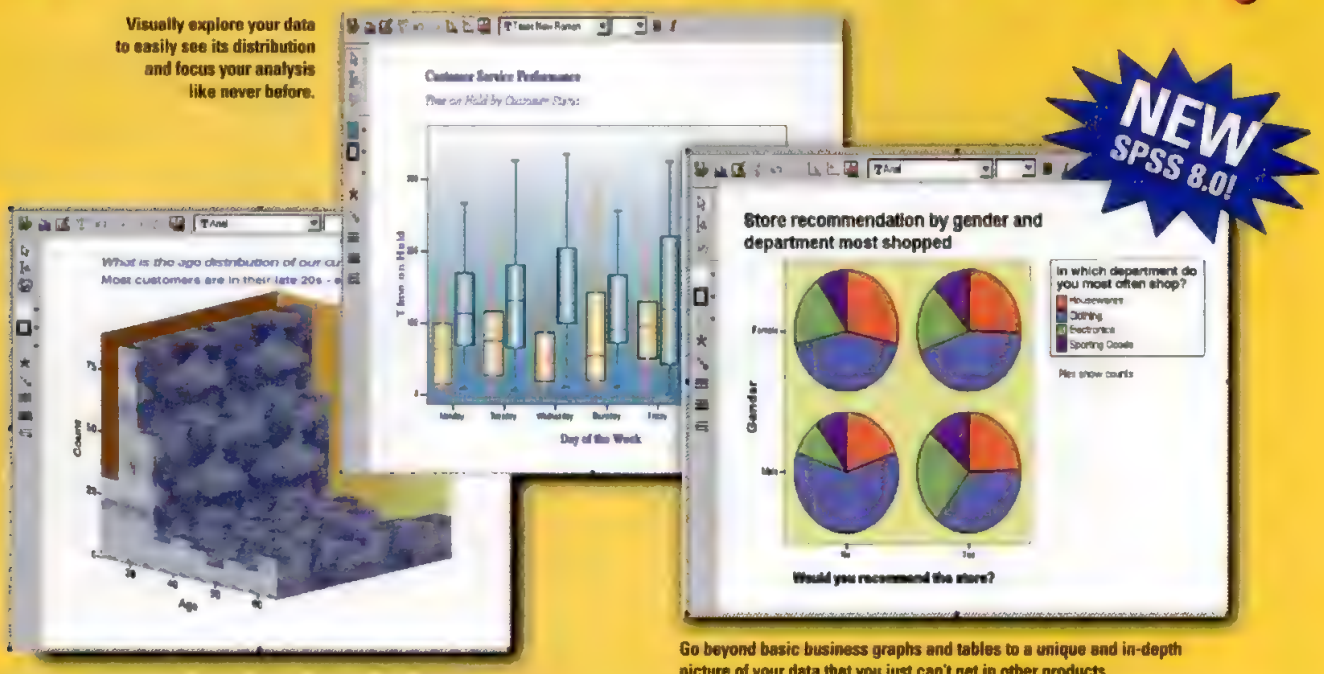

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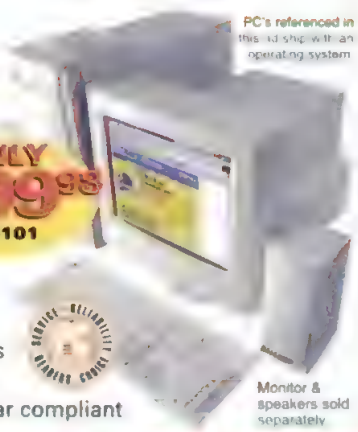

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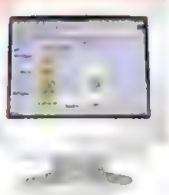

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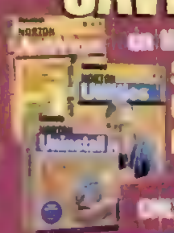

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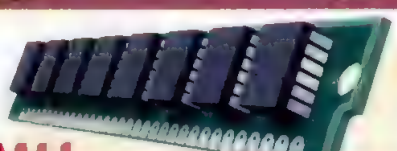

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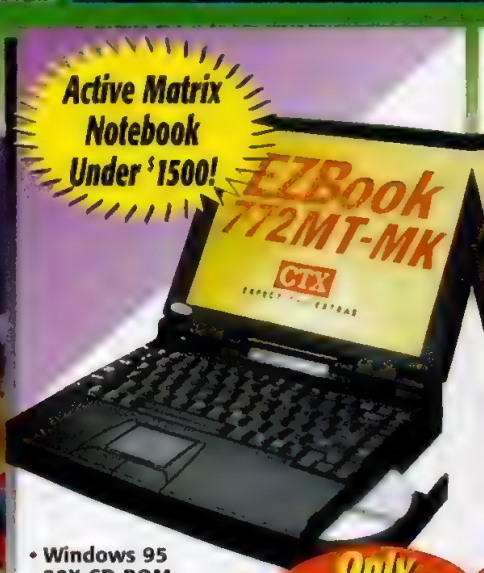

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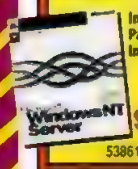

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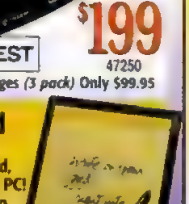

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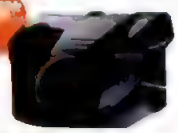

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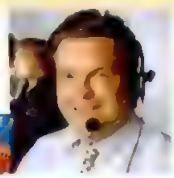

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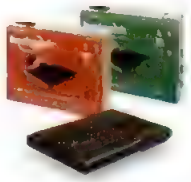

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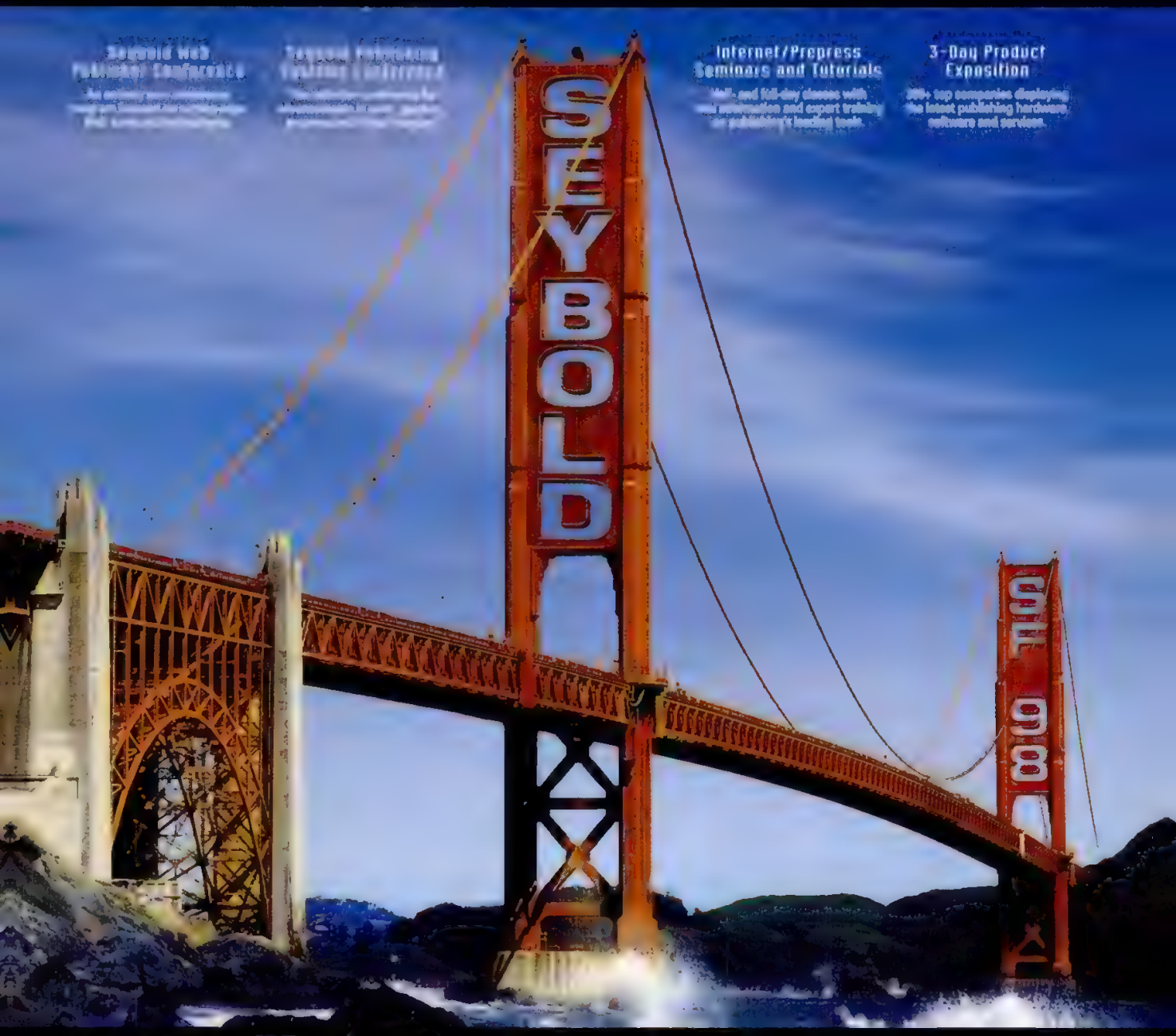

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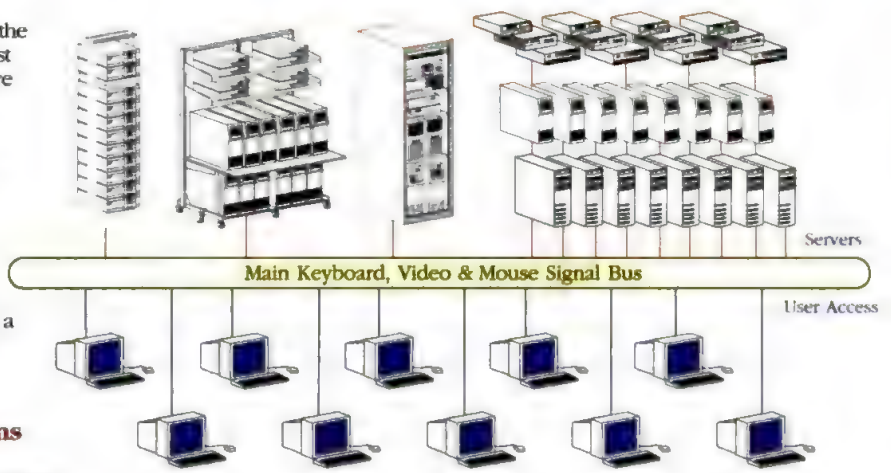

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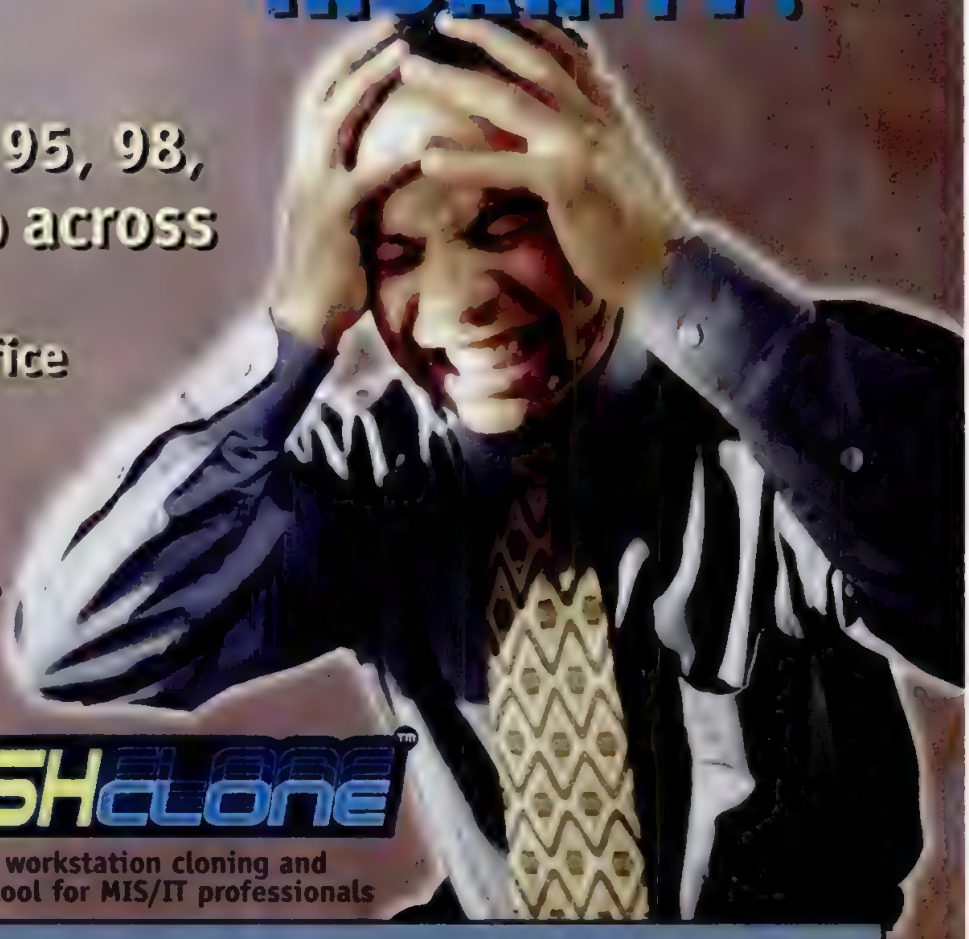

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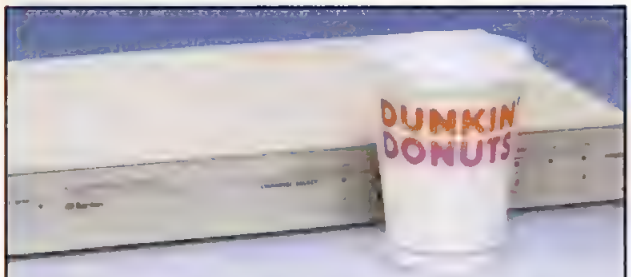

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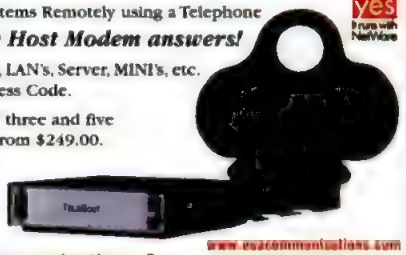

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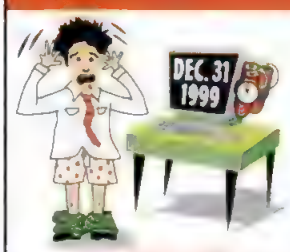

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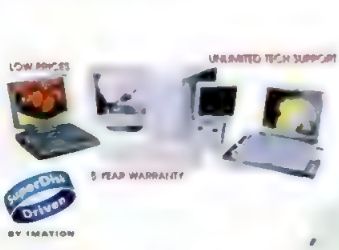

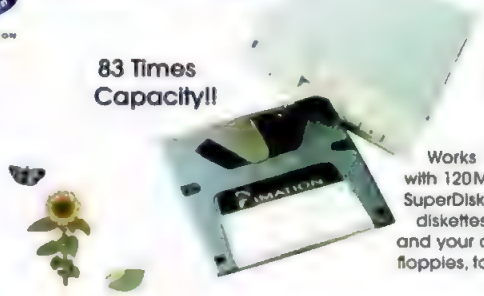

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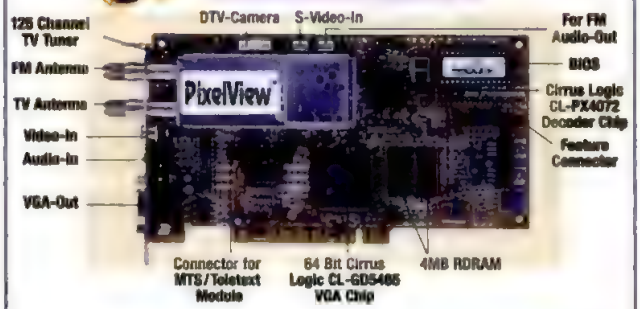

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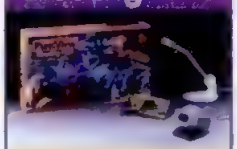

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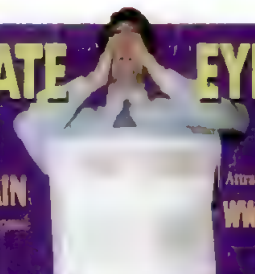

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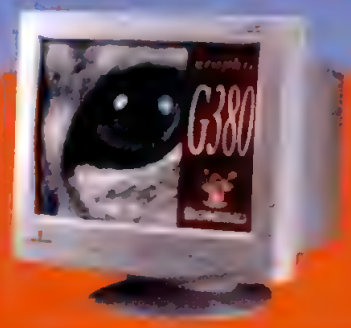

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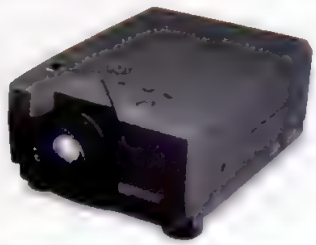

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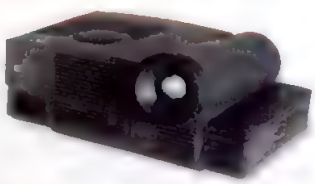

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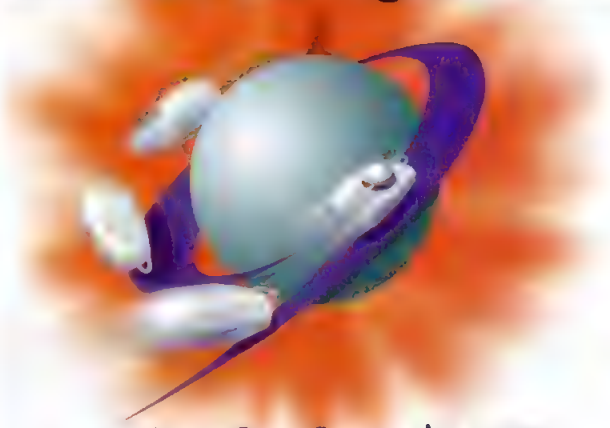

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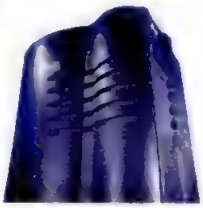

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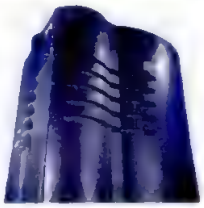

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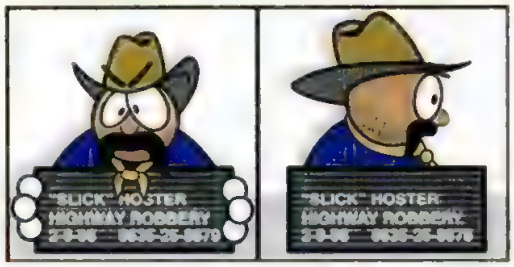

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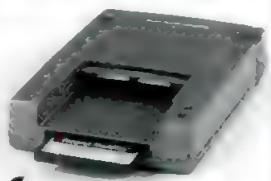
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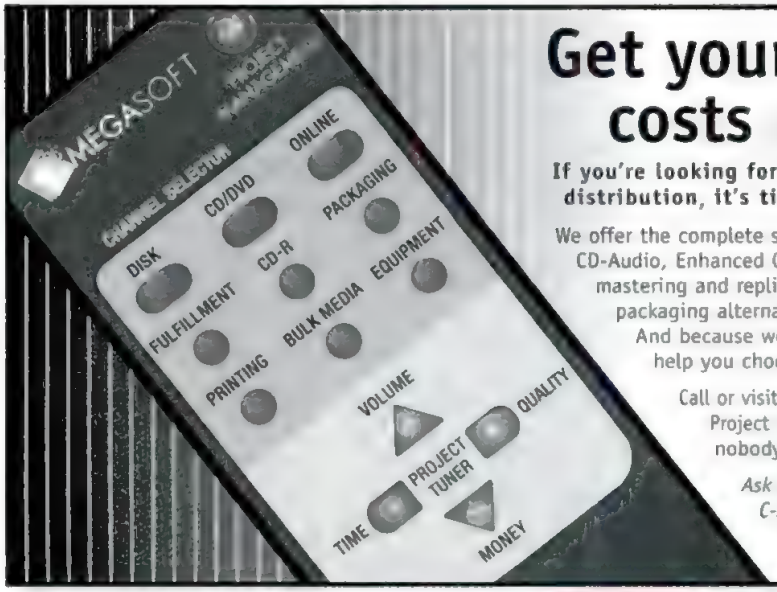

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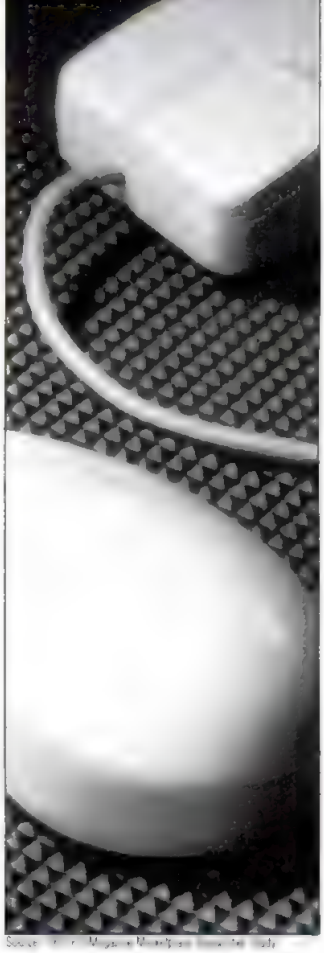

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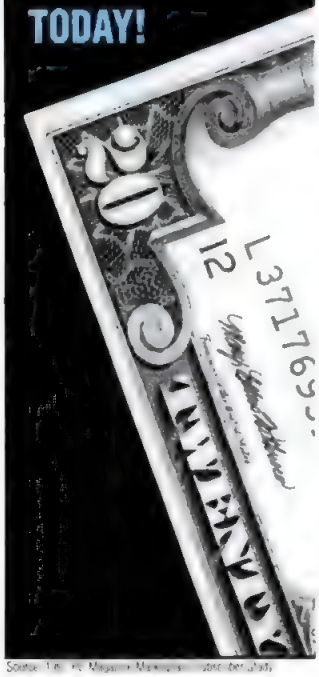

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After Hours

Home Makeover

Home remodeling software helps you plan your dream home—from bath to bedroom.

By Sally Wiener Grotta & Daniel Grotta

Sitting in your living room, with its green shag carpet and wood-paneled walls, you ponder your dream room: new furniture, perhaps even a skylight or French doors. It sounds ideal—until you start to think about the dreaded renovation process. Well, like a proverbial silver lining in the dark cloud of remodeling, home design software can alleviate some of the aggravation.

This software is the equivalent of graph paper and a pen for the computer age. Usually, the software takes one of two approaches—either 3-D modeling or photo editing. Some programs use elements of both. The programs don't take the place of a professional contractor, but they help you get your concepts into a visual form.

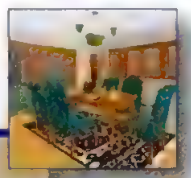
We reviewed five programs; all are relatively inexpensive and can run on any current Windows 95 computer (though you'll want one with at least 256 colors). A new entry, Bob Villa's Home Design, from The Learning Company, was not shipping as of our deadline.

Complete Home

Sierra's Complete Home is a software suite; Home Architect is its centerpiece. Also included are Electrical Wiring, 3D Deck, and Home Improvement Encyclopedia. Complete Home is a thorough but inconsistent product, with a wide range of tools.

Getting started with Home Architect is effortless. The RoomBlocks wizard walks you through four simple steps. First you define the number of rooms. Next, you resize and arrange the rooms; then you add windows and doors. The fourth step is the build, which creates both a 2-D and 3-D view that you can edit and furnish. All editing is done in the 2-D window, but changes are automatically updated in 3-D.

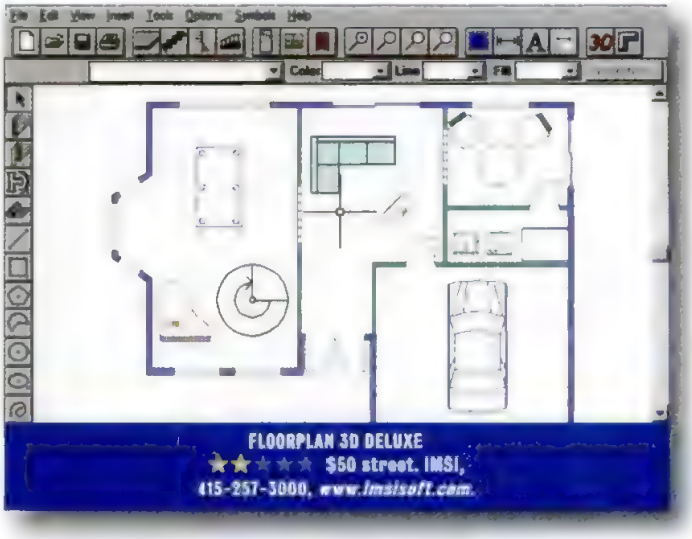
The large library of furnishings and appliances includes brand-name products. Additional objects may be downloaded from Sierra's Web site, but adding them to a layout can be problematic. For instance, although there is a snap-to option, items do not snap to the wall or to each other, nor do they always orient correctly. So in our kitchen layout, cabinets that were supposed to be built in and adjacent had to be manipulated carefully into place. Also, the rotation command is difficult to control.



Other sections offer design advice, pricing, a 3-D preview, a personal-notes window, and links to related Web sites. The Shopping List creates a price breakdown based on average costs, including installation.

3D Deck is a quick and simple program for designing a deck. It offers useful advice regarding materials and methods, though the advice is not as extensive as that of Home Architect. Electrical Wiring is a how-to guide for home repairs and electrical design. And Home Improvement Encyclopedia has remodeling tips and information.

For basic layouts and valuable information about remodeling, Complete Home is excellent, even brilliant. If editing layouts and placing objects weren't so frustrating, this would be a must-have program.



FloorPlan 3D Deluxe

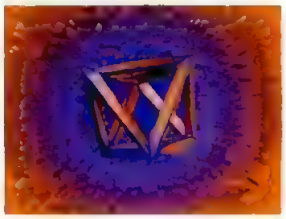
Five programs compose this suite: FloorPlan 3D, TurboCad 3D, Garden Designer, Quick & Easy Estimator, and Home Styles Interactive.

FloorPlan 3D looks promising at first glance, but it ultimately proves uneven and awkward to use. The library of objects has a large number of categories but not enough vari-

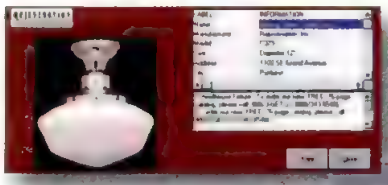
INSIDE

ALTERNATIVE ACTION
No more boring joysticks: Three hot new devices to jazz up your gaming experience. *Page 422*

A NEW ADDITION
Plus! 98 for Windows 98 adds a snappy array of desktop themes, as well as some useful utilities. *Page 427*



ety among the most commonly used items. Nor are there any visual representations of brand-name products. But TurboCad 3D can be effectively used to create custom objects that can be imported into FloorPlan 3D.



The 3-D view is noneditable and noninteractive, and it does not update along with the edits in the 2-D view. Instead, the 3-D view has to be rerendered each time you make a change to the 2-D layout. When you place objects against a wall, they do not automatically orient facing outward, and the rotation tool is difficult to control.

FloorPlan 3D exports its materials list to Q&E Estimator. This module organizes the data and provides a workbook for calculating project costs.

Garden Designer is a completely separate program, meaning you can't see your newly designed garden in relation to your newly designed home. But it is a useful component, with information about plants and their preferred environments.

Home Styles Interactive is a database of copyrighted blueprints, so if you want to use them in any way, you have to call an 800 number and negotiate a fee. But they can provide inspiration.

If your design project is something out of the ordinary, then FloorPlan 3D Deluxe's ability to work with TurboCad 3D may be just what you need.

Imagine Your Interior Design

The concept is intriguing: Imagine Your Interior Design 4.0 uses photos rather than 3-D design. You can visualize your remodeling based on photos of your own home and of actual brand-name products. Unfortunately, the program's limitations diminish its usefulness.

Imagine Your Interior Design is Twain-compliant, meaning it can import photos directly from most scanners and digital cameras. The included drawing program has some tools for editing your photo, but it is primitive and difficult to use.

Getting started isn't difficult. You define objects by outlining areas of your room (using a drawing tool), then moving the objects or filling the areas. Moving an object creates a copy that can be placed elsewhere. You can fill the area with a photo from the library (furniture, windows, appliances, wallpaper, and so on). Applying perspective to the objects is relatively simple, as is scaling them.

In case you don't have a photo of your room or want to design something from scratch, you can create a 3-D room. When you create a room, you can input height, depth, and width dimensions. But after that, you have no control over the size of items placed into the room.

Although the library is very limited, it does include brand-name products. It has no search function, however. Instead, you must scroll through tiny thumbnails, trying to find what you want. The Shopping List creates a worksheet with everything you have in your layout, but you have to supply all prices and costs.

Home Shopping Guide

✓ YES ✗ NO	Sierra On-Line **Complete Home** ★★★	IMSI **FloorPlan 3D Deluxe** ★★	Visual Applications **Imagine Your Interior Design** ★★	Autodesk **Picture This Home! Kitchen** ★★★★	Broderbund Software **3D Home Design Suite** ★★★★★
Street price	$50	$50	$50	$50	$80
Snap-to grid/Snap-to objects	✗ ✓	✓ ✗	✗ ✗	✓ ✓	✗ ✓
Snap-to wall	✓	✗	✗	✓	✓
Library includes					
Wallpaper and textures	✓	✗	✓	✓	✓
Brand-name products	✓	✗	✓	✓	✓
3-D views are linked to 2-D views for automatic update	✓	✗	N/A	✓	✓
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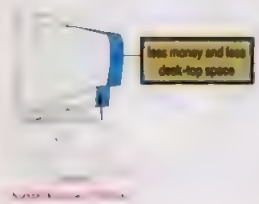
Supports multiple story designs	✗	✓	✓	N/A	✓
Direct link to company Web site	✓	✓	✗	✗	✓

N/A—Not available. The product does not have this feature.



Introducing the Hyundai DeluxScan 7770 Dream. A breakthrough 17-inch monitor whose unique reduced-depth CRT gives it virtually the same profile as a 14-incher. And that means more space and better ergonomics for users.
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The DeluxScan 7770 Dream-Another breakthrough in monitor ergonomics, convenience, and performance from Hyundai.

DeluxScan Monitors

Model	5870	7770	7770 RD	7696	9695	2595
CRT Type	15"	17"	17" Short Neck	17" High-Contrast	19" High-Contrast	21"
Viewable Area	14"	16"	15.7"	15.7"	18"	19.5"
Dot Pitch	28mm	27mm	27mm	26mm	26mm	25mm
Horiz. Frequency	30~70 khz	30~70 khz	30~70 khz	30~95 khz	30~95 khz	30~95 khz
Max. Resolution	1280 × 1024	1280 × 1024	1280 × 1024	1600 × 1200	1600 × 1200	1600 × 1200
On-Screen Menus	Yes	Yes	Yes	Yes	Yes	Yes
TCO option	TCO'95	TCO'95	TCO'95	TCO'95	TCO'95	TCO'95
Win 98 ICM profile *	Available	Available	Available	Available	Available	Available

* Windows 98 ICM profile : For display to printer WYSIWYG, Windows 98 requires ICM(Image Color Matching) profile for the display monitor. This profile is available free of charge at the place of purchase, or directly from Hyundai.

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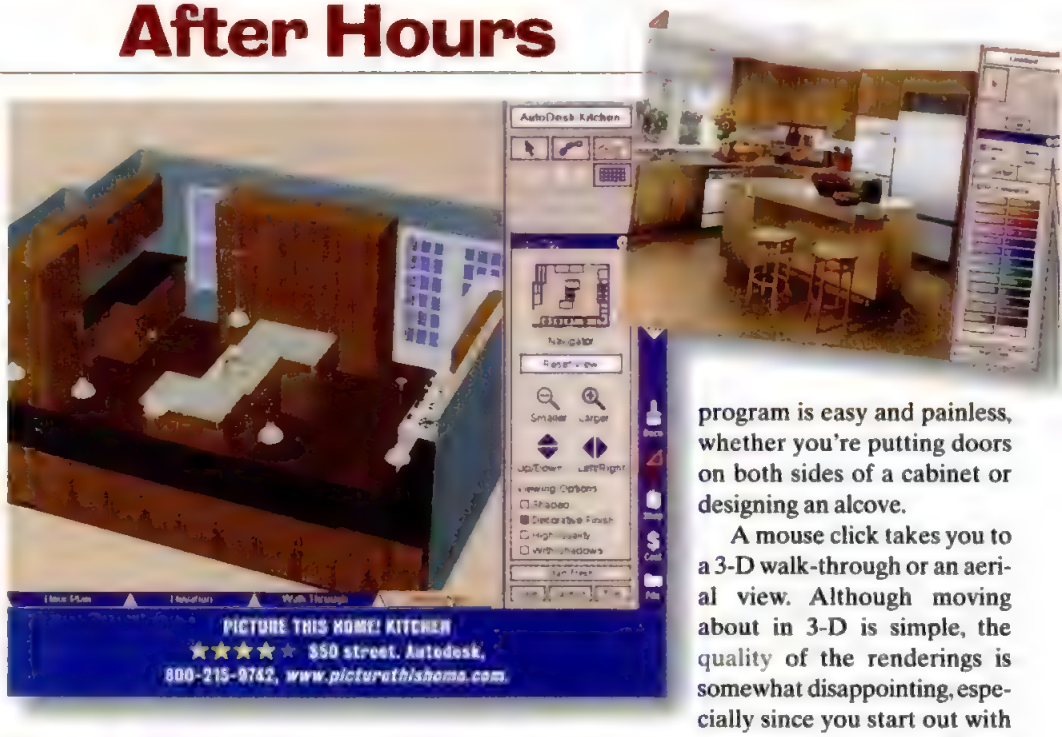
After Hours

Visual Applications says that its intention was not to create a drawing program, and it hasn't. But a drawing program, with a library of product photos, would probably be more useful.



Picture This Home! Kitchen

Picture This Home! Kitchen is fun to use and highly focused. You can design kitchens only, and the program designs them intelligently and easily (Autodesk also has a bathroom-design product). And even though the program is 3-D, the options for product, color, and texture are viewed as photographs of real products.

In Decorate and Shopping, you can bookmark photographs of products from over 25 manufacturers, including wallpaper, appliances, and cabinets. You can also develop a color scheme for your kitchen. Then, in 3D Plan, you edit an existing 2-D layout or create one from scratch. In either case, the bookmarked items can be imported into your layout (albeit not photo-realistically).

Working in 3D Plan is a delight, with objects and walls that snap to each other correctly and intuitively. You can effortlessly customize objects. Doing what you want in this program is easy and painless, whether you're putting doors on both sides of a cabinet or designing an alcove.

A mouse click takes you to a 3-D walk-through or an aerial view. Although moving about in 3-D is simple, the quality of the renderings is somewhat disappointing, especially since you start out with photographs that could have been mapped to the objects.

The Budget section creates a logical workbook in which the program inputs estimates on brand-name products and their

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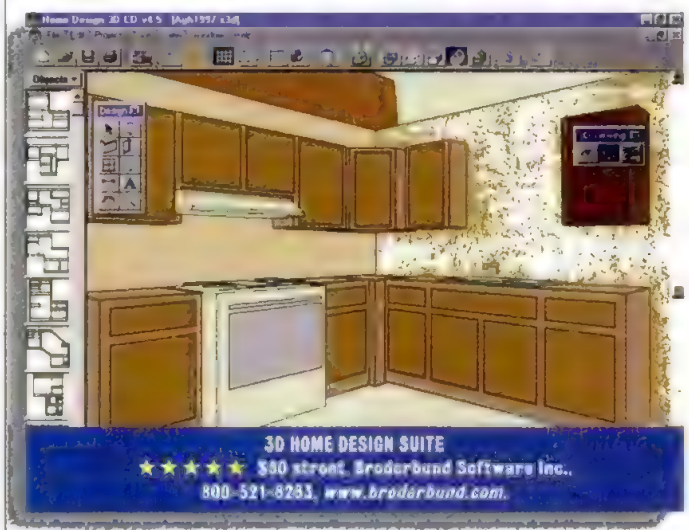
Picture This Home! is not as extensive as other programs in this roundup. But it gets the job done with ease and pleasure. And by selecting products from photos, you have a much clearer view of how your real-world kitchen will look.

3D Home Design Suite

PC MAGAZINE EDITORS' CHOICE

The anchor of the new 3D Home Design Suite is 3D Home Architect Deluxe. As a standalone product, Home Architect has been at the top of the market for some time, because it makes designing home remodels and new builds so easy. The suite also includes 3D Home Interiors and Imagine Your Landscape.



In Home Architect, you can display seven different views of your layout. As you edit, they will all update automatically. You place walls, windows, doors, and furnishings in the 2D Plan or Wall Elevation views.

Broderbund Software has advanced beyond snap-to features with its creation of SmartParts: Objects that you place into your layout have built-in intelligence, so they can read precisely where they are being put. The objects recognize which direction they should be facing and if they need to be snapped to another object.

In this program, you can perform some of the more difficult home remodeling tasks through simple dialog boxes. The tasks include placing gables over windows and doors and designing cathedral ceilings.

When you are finished with your design, you can use PlanCheck to evaluate your layout, making sure it complies with basic building standards. The materials list creates a spreadsheet of what you will need for your project, so you can map out a budget.

Although Home Architect offers only a minimal number of objects and a scanty palette of colors, 3D Home Interiors has an extensive library (containing more than 100,000 objects) of brand-name furnishings, including materials and textures, and it can import layouts from Home Architect.

The third component of the package is Imagine Your Landscape. This garden design program lets you scan a photo of your own house or import a home design from Home Architect to use in creating a landscape project.

If it weren't for Family Tree Maker®, I would never have found my family

Using Family Tree Maker, Diana found her great-great grandparents Hannah & William Hunt Wilson.

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Dear Family Tree Maker,

I became interested in genealogy because I never knew my ethnic heritage. The only ancestor name and location I knew of was that of my great-great grandfather, William Hunt Wilson who lived in Oregon.

I then decided to purchase a genealogy program, and chose Family Tree Maker because of the FamilyFinder™ Index. I went home, loaded the program, did a search in the FamilyFinder Index using my great-great grandfather's name, and it referenced a World Family Tree™ CD*. I couldn't believe my eyes!

I found the name "William Hunt Wilson" on the CD. The family tree was huge — hundreds of names! My name was not there, so I decided to contact the tree's contributor to let her know that I found the connection. I left a message, and that night, I received the long-awaited call. The contributor, who is also my cousin, was screaming on the phone because she could not believe she had found me. **I was part of a "long lost leg" that the family had not heard of for over 50 years!** We laughed, we cried, and talked all night. And now, we have contact every day — either by phone or by email.

A family reunion is scheduled to take place this Fall, thanks to Family Tree Maker. I never would have found my family if it weren't for the program.

Thank you!

Diana Gasher

San Jose, CA

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Gaming Gear

Joysticks with a twist: three alternatives to traditional play. By John Delaney

CyberStik VR9000

Gamers looking for an exciting virtual-reality experience will be impressed with the CyberStik VR9000. The unique joystick offers midair gaming control, enabling the player to get out of the chair and into the game.

The CyberStik differs from other joystick devices in that it uses a solid-state tilt-sensor design, which provides pinpoint control with a flick of the wrist. This four-button joystick also features analog/digital mode switching, throttle control, and a sensitivity switch.

CYBERSTIK
★★★ $89.96 list. CyberStuff Corp., 804-330-5970, www.cyberstuff.com.

All buttons and switches are strategically placed for comfortable one-handed operation. The CyberStik can be used in midair for the maximum virtual-reality experience or on its base as a better-than-average joystick.

Installation of the CyberStik is easy: It plugs into the game port, with no drivers to load. We tested the CyberStik by playing Terminal Velocity and found it an excellent flight controller with accurate turning and diving control. While playing Shadow Warrior, we found that the CyberStik was lacking compared to a game pad, which offers better forward, backward, and side-to-side motion control in a fighting environment.

The CyberStik has a bundled 12-game CD and a CyberStuff tote bag for handy storage of the joystick and base.

UR Gear

You'll have to use your head if you want to get the most out of UR Gear (and we're not talking about brainpower). The futuristic helmet is a head-activated 3-D controller with stereo sound. In addition to the helmet, UR Gear consists of an emitter that sits on your monitor, a game pad, connecting cables, and a CD containing game demos and speech recognition software. Though UR Gear supports speech recognition for office applications, we tested it solely as a game controller.

Color-coded cabling and an instruction manual make installation foolproof. After installing, all you need to do is calibrate. Watch out, though: If you don't maintain the correct distance from the emitter, calibration is difficult and control is erratic.

We tested UR Gear playing Hexen II and found we were able to do battle using head movements for running and turning and the game pad for firing and jumping. As a flight controller with Terminal Velocity, UR Gear proved as accurate as any joystick we've seen.

UR GEAR
★★ $99.00 list. Union Reality, 818-592-0400, www.unionreality.com.

The stereo headphones provide adequate sound while blocking out outside noise, resulting in a near-total immersion experience. The downside is that after 15 minutes or so, the one-size-fits-all headset feels uncomfortable and stuffy—and makes for a bad hair day.

Vortex 3D

Looking for one game controller that does it all? The Vortex 3D is a joystick, game pad, and steering controller all in one.

The Vortex 3D offers digital and analog control, six rapid-fire buttons, and a throttle control and is detachable from its base for use as a game pad. As if that weren't enough, there are also two triggers and an auto-fire button within easy reach.

Installation is a snap. Once you've loaded the drivers and connected the cable to the game port, you simply pick the configuration that best meets your needs. There are seven options, including flying, fighting, and three driving configurations.

We tested the Vortex 3D while in fighting (Hexen II), flying (Terminal Velocity), and driving (Need For Speed II) modes. All three configurations provided smooth game play and accurate steering control. Though not as responsive as a top-of-the-line steering wheel, the Vortex 3D still performed admirably. We did notice when using the device as a flight controller that it tended to detach itself from the base if pulled back too hard.

The Vortex 3D combines accuracy with ease of use and a sleek design, making it one of the better multifunction game controllers on the market today.

VORTEX 3D
★★★★ $69.99 list. InterAct Multimedia Products, 800-732-6866, www.interact-acc.com.

PHOTOGRAPHY BY THOM O'CONNOR

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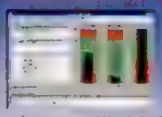

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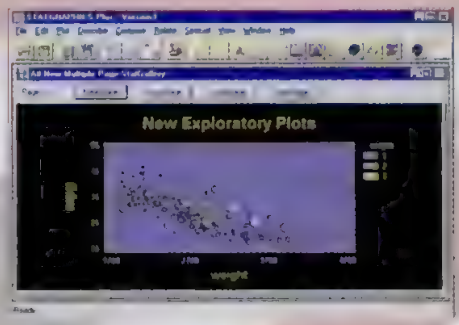

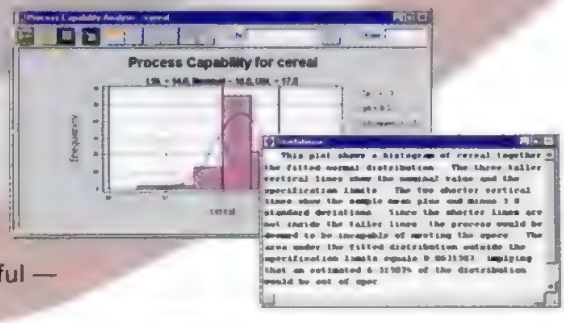

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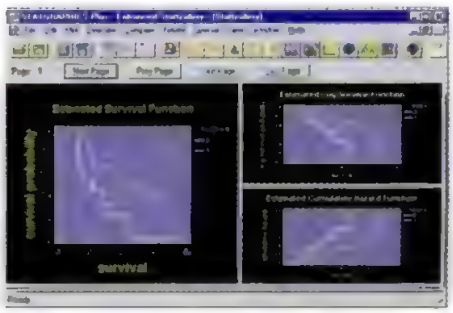

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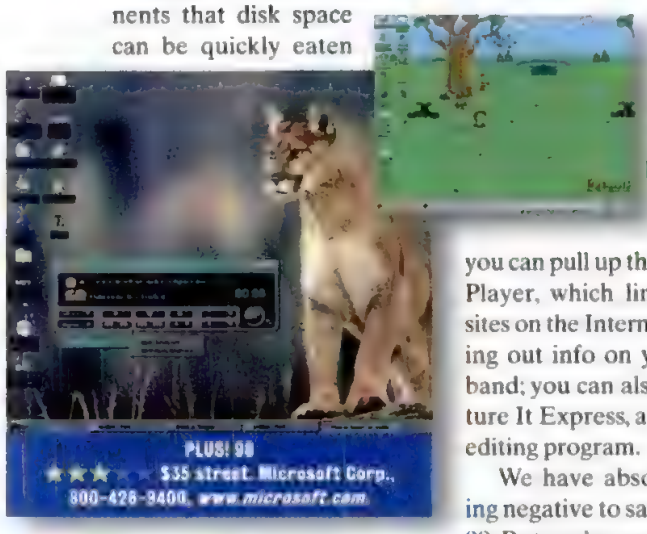
It Does Windows (98)

Plus! 98 is a companion to Windows 98 that's equal parts fun and practical.

Quake II, Total Annihilation, and Dark Reign all have expansion packs that add more levels, more characters, and more fun. Not to be outdone, Windows 98 has its own add-on. The Plus! 98 CD-ROM adds more desktop themes, games, and utilities to Microsoft's operating system.

People may perceive Plus! 98 (and its Windows 95 counterpart, Plus!) as mere set decoration—amusing desktop themes and animated icons and cursors. The package does, however, have a few more tricks up its (jewel case) sleeve. Utilities such as McAfee VirusScan, disk cleanup, and Maintenance Wizard (the latter two are more full-featured versions of programs already incorporated into Windows 98) tune up your hard disk. You can schedule them to run automatically—say, once a day or weekly.

Installation is a no-brainer, and the program offers to run the antivirus software for you before setup. You have a choice of custom or complete install, and we recommend that you browse through the custom install and select only the components you plan to use. There's no point in loading Golf 1998 Lite if you are never going to play. Plus! 98 consists of so many components that disk space can be quickly eaten up by a full install. Also during setup, you can schedule the Maintenance Wizard to perform PC fine-tuning.



Once you've installed Plus! 98, don't expect to configure your desktop themes (there are more than two dozen—from Science Fiction to Peanuts) from the Control Panel; you access them from the Start menu instead. From there, you can pull up the Deluxe CD Player, which links to music sites on the Internet for searching out info on your favorite band; you can also access Picture It Express, a basic photo-editing program.

We have absolutely nothing negative to say about Plus! 98. But we've got to ask: Why weren't its components simply added to Windows 98 during the development of the OS? —*Jennifer Triverio*

Coming Up

What's in the Next Issue of *PC Magazine*

Low-Cost PCs

Sub-zero PCs, value PCs: Whichever moniker you use for them, desktops priced below $1,000 have carved out a salient portion of the consumer market in the past year. With our first feature-length roundup of value PCs, we review nearly 50 home and SOHO machines running Windows 95. Processors vary from Celeron to the 200-MHz Pentium MMX to the 300-MHz Pentium II, but each system sells for under $1,000, sans monitor.

Remote-Control Software

Beyond e-mail and using the Internet, many people still need to connect to office PCs using remote-control software. And this market is diverging as many IS departments use remote-control packages in help-desk solutions and many PC vendors use them to provide support. Find out how the latest packages for Windows 95 and Windows NT fared.

Web Portals

This term has drifted into the lexicon and into public consciousness over the past year. Search sites and other site entities are trying to transform themselves into all-purpose portals and become your entry point to the wonders of the Net. We'll scrutinize all the portal wanna-bes.

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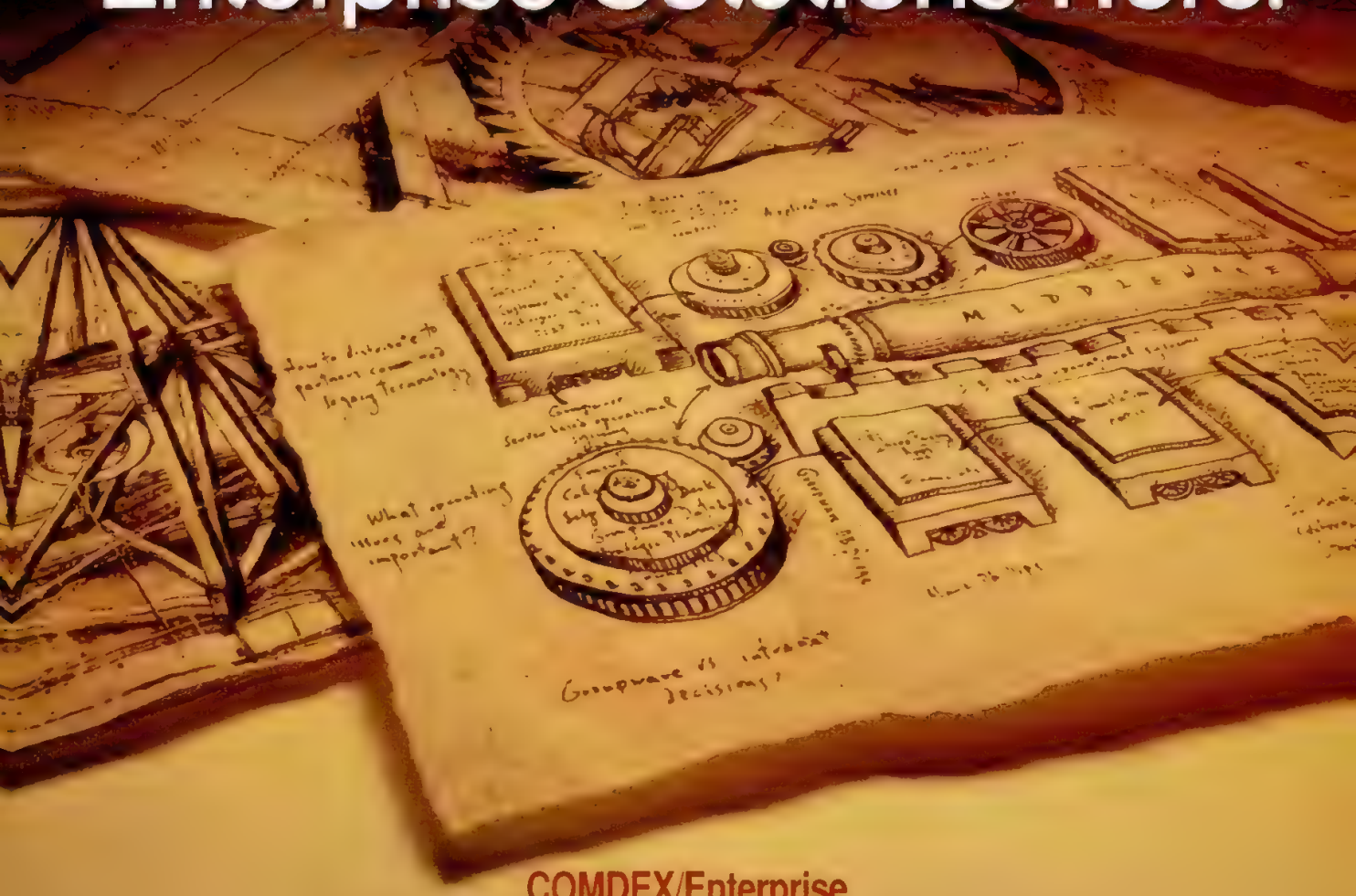

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TNB-13G	Intel Pentium Mobile 266 MMX	64MB	3.2 GB UDMA	24X	13.3" Active Matrix	$79	$2,239.99
TNB-14A	Intel Pentium II 233 MMX	64MB	3.2 GB UDMA	24X	14.1" Active Matrix	$84	$2,379.99
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Abort, Retry, Fail?

We're sorry -- PEOPLE Online's Most Beautiful People Poll is getting a lot of traffic. Please check back soon to vote.

In the meantime, take a look at the results so far:

1. Hank the Angry, Drunken Dwarf, 5146
2. Leonardo DiCaprio, 4338
3. Michelle Kwan, 2597
4. Faye Wong, 2544
5. Kate Winslet, 2361

Here's what happened when Howard Stern fans sabotaged *People* magazine's online poll selecting the world's most beautiful person.

Year-2000 Problem Problem

The Microsoft Developers Network set up a special Web site to discuss "Microsoft and Year 2000 Issues," and it appeared that Microsoft did, in fact, have some issues to discuss. The Web site address it listed was *www.microsoft.com/year200/*.

We see this backwards keyboard mistake all the time, but rarely on the cover of a magazine. *IT Blues*, shame on you!

A Home Run for Apple?

Faithful reader Dave Burchett, who lives across the street from a Little League baseball field, noticed one morning that home plate had been stolen. Not to worry. When the groundskeeper arrived, he calmly dug a shallow hole at the spot and filled it with an old Apple IIc computer. Burchett reports that it served quite well as home plate until a lower-tech solution was found.

Intel, You've Got Some 'Splainin' to Do!

Why did Intel name its new processor "Celeron"? We're not sure, but we do want to point out that Celoron, New York, a small town of 1,200 located on the shores of Lake Chatauqua, is the hometown of none other than legendary queen of comedy Lucille Ball. Guess you could say the chip runs at 266 mega*mertz*.

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Here's a PC with plumbing problems. (KLX Systems ad.)

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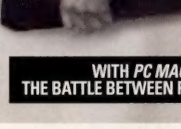

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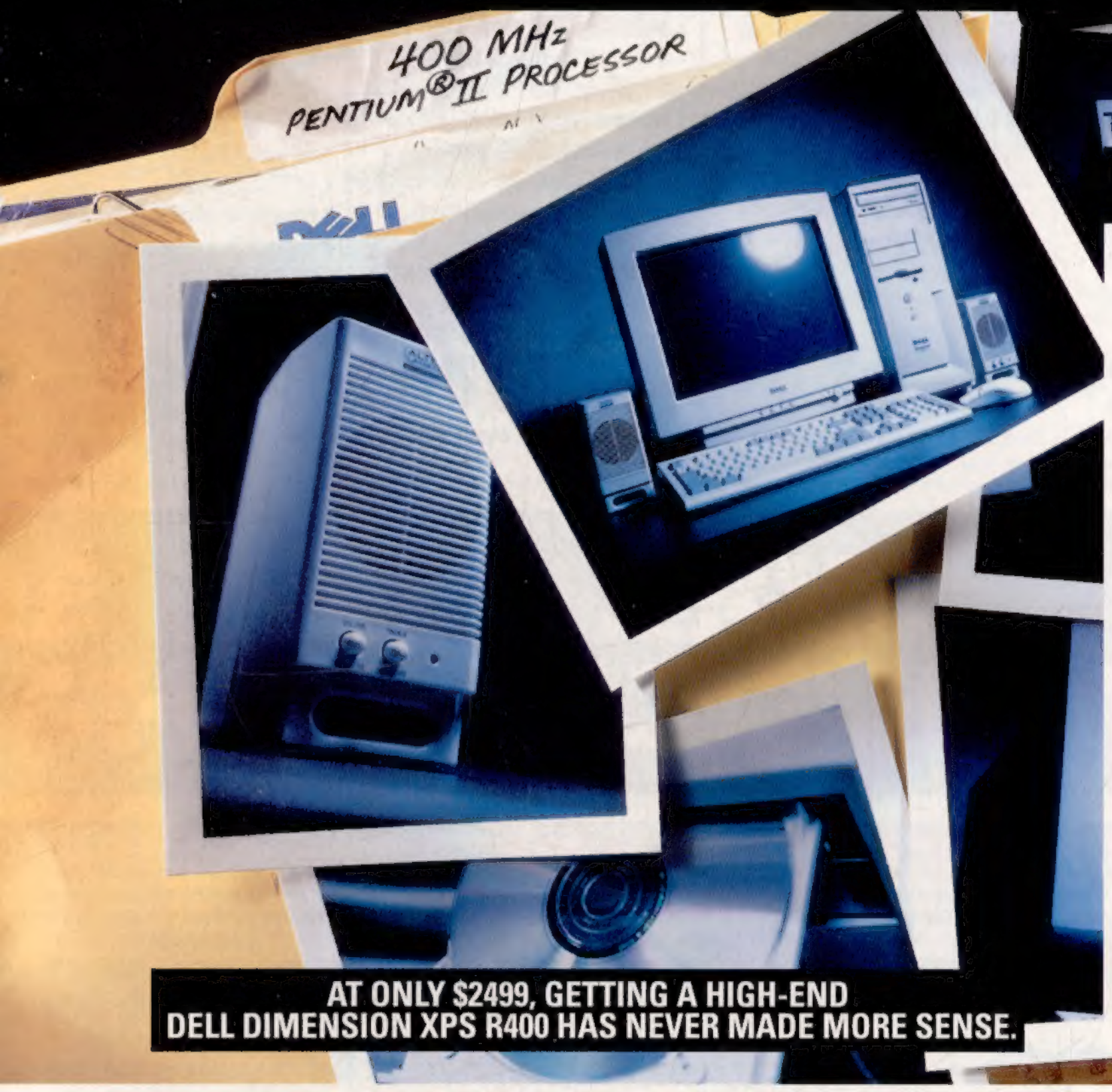

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